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· DECEMBER · 1917 ·

ANNUAL MEETING, NEW YORK, DEC. 4 TO 7

ANNUAL MEETING PAPERS CONTINUED IN THIS ISSUE

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Entered as second-class matter, January 4, 1912, at the Postoffice, New York, N. Y., under the act of March 3, 1879.

The Thirty-Eighth Annual Meeting of The American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York, December 4 to 7. The program of the meeting, giving details of professional sessions, committee meetings, sections conferences, titles of addresses, titles and authors of papers, etc., is given on pages 1004 and 1005.

Publication of the papers was commenced in the October issue and has been continued in the successive issues; publication in The Journal is in comprehensive abstract form and simultaneously the papers are being printed in extenso in pamphlet form and copies may be obtained gratis by members on request. Contributed discussion of the Annual Meeting papers is solicited and will be presented at the meeting and subsequently published in The Journal. A full account of the Annual Meeting will be presented in the January Issue.

THE COOLING OF WATER FOR POWER-PLANT PURPOSES

By C. C. THOMAS, BALTIMORE, MD.

Member of the Society

THE purpose of the work here described was to ascertain the conditions governing the cooling of water by means of spray ponds. This involved determining the efficiency of the cooling process under varying conditions of pressure at the spray nozzles, the temperature of water to be cooled, the power applied to the pumps, the height of sprays above the pond, etc. The work has resulted in a large collection of data, part of which is presented here, and also in the development of the new form of spraying device described.

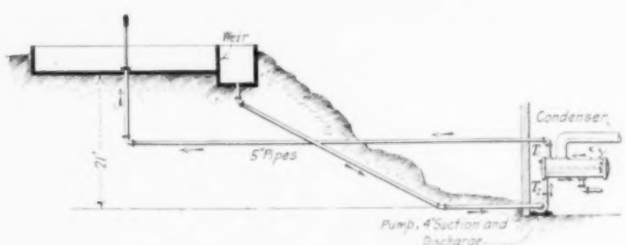

FIG. 1 COOLING SYSTEM USED IN THE EXPERIMENTS

EXPERIMENTAL WORK

The experiments were made on the pond shown in Fig. 1, which is part of the power plant and laboratory equipment of The Johns Hopkins University, Department of Engineering. The pond is 35 ft. in diameter and 4 ft. deep and was designed with special reference to experimental work, as well as to cool the condensing water for a 50-kw. Buckeyemobile fitted with a surface condenser. The water is ordinarily sprayed through one spray head, or nozzle, of the new type described in this paper, but some of the tests were made with nozzles of other types. A motor-driven centrifugal pump with 4-in. suction and discharge sends the water through the condenser tubes and to the spray head, as shown in Fig. 1.

The pressure at the spray head or other type of nozzle was in all cases measured by a mercury column connected to the entrance of the spraying device, and the recorded pressures are for that point. Wind velocity was measured by a standard anemometer, and the humidity by a wet-and-dry-bulb sling psychrometer. The amount of water circulated was measured by a 10-in. weir fitted with a micrometer hook gage.

About six hundred tests have been made, mostly with the new type of spray head shown in Figs. 2, 3, and 4, but tests Nos. 11 to 18, 86 to 91, and many others not reported here, were made with three sizes (3-in., 2-in., and 1-in.) of nozzle having spiral cores, as shown in Fig. 5. Data representative of the tests are given in an appendix.

It was desired to ascertain, among other things, the effect of placing a wire fly-screen cylinder about the spray head, and many of the tests were so made, as shown in the appendix.

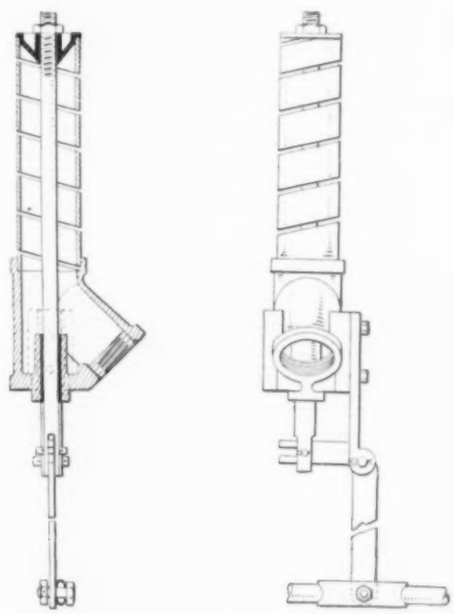

FIG. 2 THOMAS ADJUSTABLE SPRAY HEAD, CLOSED AND OPEN

THE AUTHOR'S ADJUSTABLE SPRAY HEAD

The adjustable spray head is shown in Figs. 2 and 3. It consists of a cast-iron supporting base containing the water-entry opening and carrying a 3¼-in. outside-diameter bronze tube in which is cut a spiral opening of coarse pitch. This opening is cut with a tool placed at an angle of about 60 deg. with the axis of the tube, so that the water is thrown upward at this angle. The spiral tube is held between the base and

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a cap which fits the top by means of a central bronze stem which passes down through a close-clearance bushing in the base. This stem is movable and is operated by a bell crank having an extended vertical arm giving accurate control of the position of the stem. The result of the motion is either to increase or decrease the fineness of the film of water as it leaves the spray head. When the head is in operation the water is discharged in a continuous sheet in a direction which

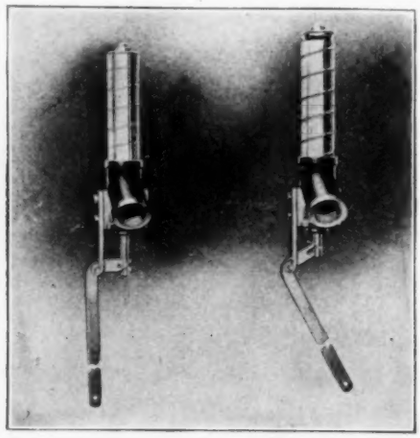

FIG. 3 SECTION AND ELEVATION OF THOMAS ADJUSTABLE SPRAY HEAD

is inclined upward, due to the angle of the spiral opening. As the water film spreads it becomes thinner, on account of its increasing diameter, until a point is reached where the surface tension is overcome and the sheet of water breaks into either a uniformly fine spray, a mist, or a large number of small drops, depending upon the size of opening to which the spray head has been adjusted. This principle of spraying a liquid as the result of the spreading of a film of water until it breaks into mist, or spray, or fine drops, is particularly applicable to low-pressure work, and it will be noticed that the pressures used in the experiments described are relatively low, being in general from 5 to 8 in. of mercury. A pressure of 10 in. gives an exceedingly fine spray, and in general 8 in. at the spray head is ample. Of course, the higher the pressure, the more extensive is the cooling, and this is true with all forms of nozzle.

EFFICIENCY OF COOLING PONDS AND TOWERS

The efficiency E of a cooling pond or tower may be expressed as the ratio between the cooling actually produced, $T_1 - T_2$, and that which would have resulted from cooling the water down to the dewpoint or wet-bulb temperature T_w. Thus,

$$E = \frac{T_1 - T_2}{T_1 - T_w}$$

T_1 and T_2 being the temperatures of the water before and after cooling, respectively. A perfect atomizing device would be one capable of subdividing the water so that evaporation would take place at T_w, and to an extent such as to lower the temperature of the remaining liquid spray to that temperature.

The curves in Figs. 6 and 7 show variation of efficiency of the adjustable spray head with variation of pressure and with variation of capacity, respectively, for three initial temperatures, namely, for $T_1 = 98$, 105 and 125 deg. fahr. These results were obtained by adjusting the spray head to suit the weather conditions existing at the time. From these curves the cross curves on Fig. 8 were drawn, for use in predicting the cooling range to be expected from a given set of conditions. This may be done as follows:

From these curves the efficiency to be expected for any given initial temperature T_1 and for any given pressure at the nozzle, may be found. If an initial temperature of water, T_1, and an average air temperature, T_a, and humidity be assumed for the locality of the cooling pond, the expected cooling range may be worked out. For example, if $T_1 = 115$ deg. and $T_a = 70$ deg. and if humidity = 0.55, then, from a humidity table, $T_a - T_w = 10$ deg. or $T_w = 70 - 10 = 60$ deg., and

$$T_1 - T_w = 115 - 60 = 55 \text{ deg.}$$

Let the pressure at the nozzle be 10 in. mercury. From the curves, the efficiency to be expected in cooling water from 115 deg. by spraying it with 10 in. mercury pressure at the nozzle is

$$\frac{T_1 - T_2}{T_1 - T_w} = 0.70$$

The cooling range will then be

$$T_1 - T_2 = 0.70\ (T_1 - T_w) = 0.70 \times 55 = 38.5 \text{ deg.}$$

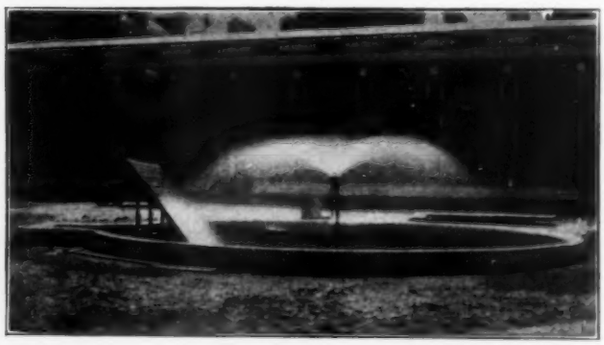

FIG. 4 THOMAS ADJUSTABLE SPRAY HEAD IN OPERATION

FIG. 5 NON-ADJUSTABLE NOZZLE WITH SPIRAL CORE

It is of interest to observe the wide variation of efficiency shown in Fig. 9 which takes place during a long period of operation when no attempt is made to adjust the spray head so as to obtain uniformly good results. The tests yielding these points cover about a year. The heavy black circles indicate results from the non-adjustable nozzles, while the others refer to the adjustable spray head when operated under widely varying weather conditions, pressures, and temperatures of water, without any attempt to obtain high efficiency. It will be noticed that with the non-adjustable nozzles, such as shown in Fig. 5, the pressures used are high and capacities very low as compared with those for the adjustable spray head.

Fig. 10 shows for a few related tests the variation of cooling range, $T_1 - T_2$, with pressure at the spray head.

A curve was obtained showing better efficiencies with the

water falling upon the bare cement bottom as compared with those resulting when the pond contained its normal amount of water. These results are rather surprising, and it is hoped that further tests may be made to confirm or to controvert them. If a bare pond would serve as well as one containing water, the construction of the pond could be cheapened, since less weight would come upon the foundation and less material would be required for the pond as a whole.

FACTORS INVOLVED IN THE PROBLEM OF COOLING WATER

The loss due to evaporation during a period of eight days is shown in Table 1. These data are not yet complete, but the average evaporation may probably be taken as about 2.25 per cent. This will, of course, vary with weather conditions, initial temperature of water, pressure at the nozzle, and with humidity. A large number of tests made with water at high

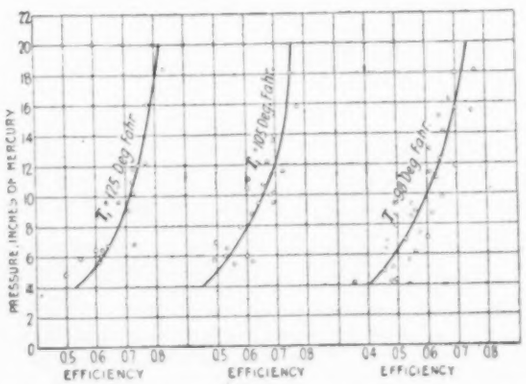

FIG. 6 VARIATION OF EFFICIENCY OF ADJUSTABLE SPRAY HEAD WITH VARIATION OF WATER PRESSURE

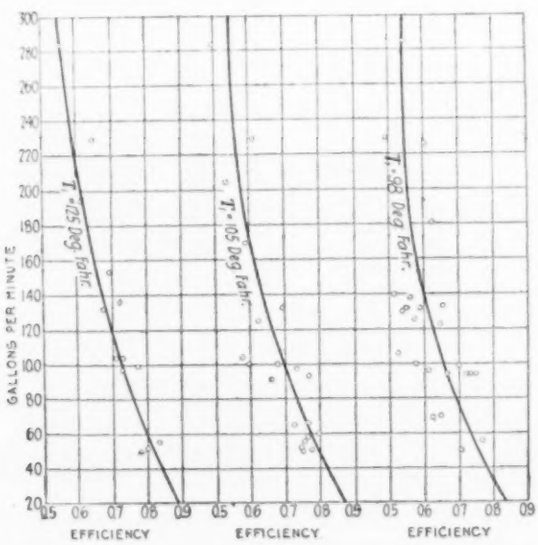

FIG. 7 VARIATION OF EFFICIENCY OF ADJUSTABLE SPRAY HEAD WITH VARIATION OF CAPACITY

and low initial temperatures indicate that 2 to 2.5 per cent per hour represents fairly well the average loss of water, but that it may be as low as 0.30 per cent, and in windy weather as high as 10 or 15 per cent with non-adjustable nozzles.

Extended observations on a pond at Sparrow's Point, Md., for cooling gas-engine-jacket water show the average loss in 24 hours to be 6 in. depth of water. The pond is 60 ft. x 40 ft. and the water circulated amounts to 2000 g.p.m. The loss is therefore about 0.31 per cent per hour.

The upper left hand point in Fig. 11 was obtained from tests on this pond.

The power required to circulate the water is shown in Fig. 12, as watts per gallon per minute per degree of cooling, from varying initial temperatures. In order to test the accuracy of this curve, experiments were made on the pond at Spar-

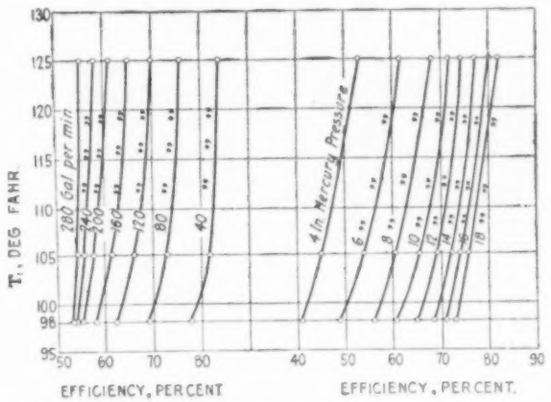

FIG. 8 CURVES FOR PREDICTING COOLING RANGE TO BE EXPECTED FROM A GIVEN SET OF CONDITIONS

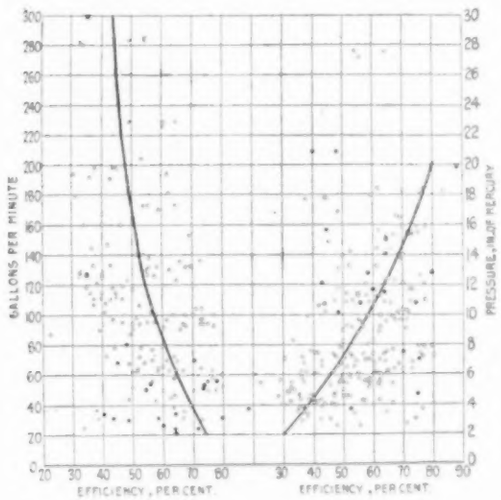

FIG. 9 CURVES SHOWING WIDE VARIATION OF EFFICIENCY WHEN PROPER ADJUSTMENT OF SPRAY HEAD IS NEGLECTED

(Black circles indicate results from non-controlled nozzles)

row's Point, which is equipped with two sets of nozzles, either of which may be used. One set consists of 42 non-adjustable, spiral-core nozzles, and the other set of 12 of the adjustable spray heads described in this paper. The power required with the adjustable spray heads at Sparrow's Point is shown by the point so marked in Fig. 11, the other points being from the Johns Hopkins pond. From this curve the power required to circulate the water in a given case can be estimated, to cover specified temperature and capacity. The power appears to be practically independent of the type of spraying device used. The average power required to drive the pump may be calculated from the following equation representing the curve drawn through the experimentally determined points in Fig. 11:

$$P = \left(\frac{100}{T_1}\right)^{3.33}$$

where P = power of the pump motor in watts per gallon per minute per degree fahrenheit of cooling, and T_1 = initial temperature of the water to be cooled, deg. fahr. (not absolute temperature). The cooling seems to be principally dependent upon the energy put into forcing the water through some suitable spraying device, and given the requisite energy a great variety of forms of nozzle would yield about equally good results. The operating advantages of the adjustable spray head and its large capacity greatly facilitate keeping the heads clean without shutting down to clean them. It also permits

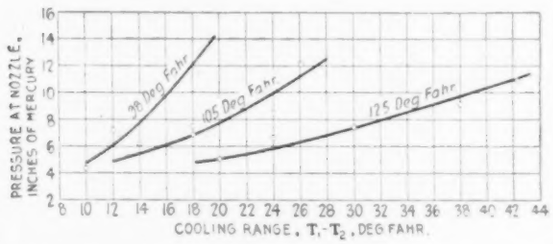

FIG. 10 VARIATION OF COOLING RANGE, $T_1 - T_2$, WITH VARIATION OF PRESSURE AT THE SPRAY HEAD

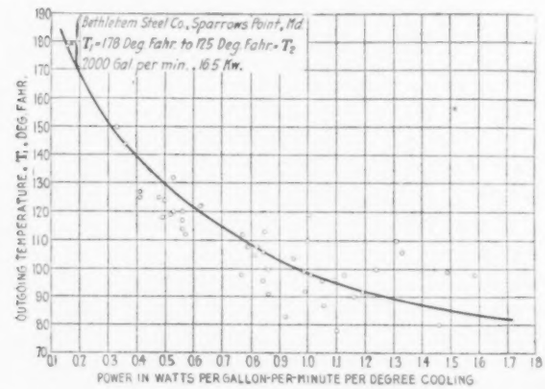
Bethlehem Steel Co., Sparrows Point, Md.
T_1=178 Deg Fahr. to 125 Deg Fahr.+T_2
2000 Gal per min., 165 Kw.
OUTGOING TEMPERATURE, T_2, DEG FAHR.
POWER IN WATTS PER GALLON-PER-MINUTE PER DEGREE COOLING

FIG. 11 POWER REQUIRED TO CIRCULATE WATER IN COOLING SYSTEM FROM VARIOUS INITIAL TEMPERATURES

regulation of the spray to suit weather conditions and to minimize loss of water and inconvenience to the nearby buildings due to driftage in windy weather. The amount and cost of piping are comparatively small for the adjustable spray head, since each one will handle from 150 to 250 gal. per min. In general, each adjustable spray head will handle the condensing water for a 50- to 75-kw. plant.

Curves are also shown in the complete paper of the effect of wind velocity upon the cooling range, the effect of spraying upon a series of superposed inclined cement plates, and of the cooling range as affected by the amount of water sprayed by a given adjustable spray head. The factor of height of spray nozzles above the surface of the pond is also considered.

It has been found to be very difficult to take account of all the variables involved in the problem of cooling water, and perhaps no one formula will cover the matter completely. It is hoped that further investigation will serve to define the effect of humidity and wind velocity and some of the other variables, and that this paper may perhaps stimulate others to do more complete work than the writer has been able to accomplish.

CONCLUSION

[In his conclusion, the author considers other methods of cooling water, and compares the results with those obtained from spray ponds.

Fig. 12 shows a cooling pond equipped with adjustable spray heads for 2500 kw. capacity of turbines.]

The experimental pond shown in Fig. 1 was built in 1914

TABLE 1 TESTS WITH ADJUSTABLE SPRAY HEAD, AT LOW PRESSURE AND AT LOW INITIAL TEMPERATURES, TO ASCERTAIN LOSS OF WATER DUE TO EVAPORATION

Test number	1	2	3	4	5	6	7	8
Date, 1917	9-27	9-28	9-29	10-3	10-4	10-5	10-6	10-8
Duration of test, hours	6½	6½	4½	8	8	8	6	8
Hook-gage zero, ft.	1.422	1.422	1.422	1.422	1.422	1.422	1.411	1.411
Hook gage, first reading, ft.	1.593	1.592	1.592	1.577	1.571	1.597	1.598	1.511
Hook gage, last reading, ft.	1.565	1.570	1.582	1.571	1.552	1.584	1.545	1.481
Loss on hook gage, ft.	0.028	0.022	0.010	0.006	0.019	0.013	0.053	0.030
Pressure at nozzle, in. mercury	4.27	6.10	3.00	5.24	6.74	6.23	6.59	5.10
Temperature at inlet, T_1, deg. fahr.	86.0	83.5	84.0	73.9	79.6	81.6	70.3	80.0
Temperature from pond, T_2, deg. fahr.	80.4	77.8	78.0	70.6	73.6	74.3	64.6	70.2
Cooling range, T_1-T_2, deg. fahr.	5.6	5.7	6.0	3.3	6.0	7.3	5.7	9.8
Dry-bulb temperature, T_a, deg. fahr.	75.8	75.7	76.0	59.6	75.2	73.1	59.4	63.5
Wet-bulb temperature, T_w, deg. fahr.	66.6	68.2	66.0	57.1	62.0	61.9	50.1	56.5
Depression, T_a-T_w, deg. fahr.	9.2	7.5	10.0	12.5	13.2	11.2	9.3	7.0
Humidity, per cent.	62	70	60	46	47	53	53	65
Loss of water,[1] per cent per hour	2.49	1.99	1.30	0.483	1.59	0.934	4.99	4.11

[1] Average loss of water (8 days), per cent per hour, 2.23.

The average efficiency for the 8 days covered by the above tests is 32½ per cent, and this will be seen to correspond with the 6-in. pressure curve (extended) in the T_1 and efficiency curves on Fig. 8. With such low initial temperatures and pressures this represents the efficiency and cooling range to be expected.

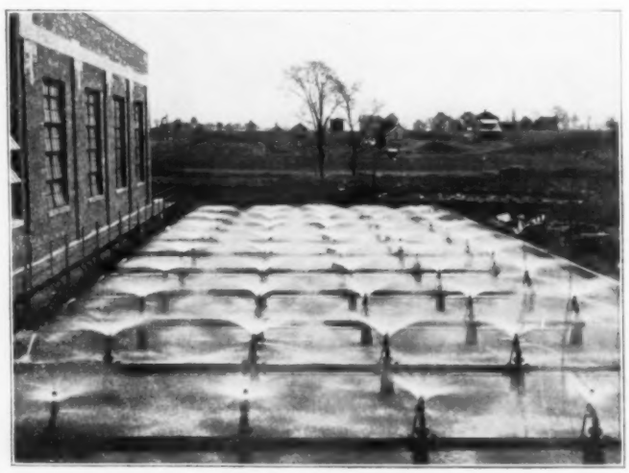

FIG. 12 COOLING POND WITH ADJUSTABLE SPRAY HEADS FOR STATION OF 2500 KW. CAPACITY

for the dual purpose of serving the University power plant and permitting investigation of the problems discussed in this paper. The writer has had much assistance from others, and is particularly indebted to Mr. W. J. Dana, Instructor in Mechanical Engineering, Johns Hopkins University, to Mr. John P. Powell, Superintendent of Gas Engines, Bethlehem Steel Company, Sparrow's Point, Md., and to the C. H. Wheeler Manufacturing Company, Philadelphia.

A COMMERCIAL ANALYSIS OF THE SMALL-TURBINE SITUATION

By W. J. A. LONDON, SPRINGFIELD, MASS.

Member of the Society

EIGHT years ago the Society was presented with a very valuable and complete paper,[1] by Mr. George A. Orrok, Mem.Am.Soc.M.E., on the small-turbine situation at that time. A great deal of further development has naturally taken place since then, changed operating conditions calling for considerable modifications in design. Increased competition, and a broader conception of the possibilities and limitations of various types, have resulted in a gradual elimination of certain principles of operation and a general trend toward the adoption of one common type.

We have seen during the last six or seven years a very marked tendency toward standardization of type in the larger machines. Practically every builder has resorted to the *composite* type, i.e., multi-velocity staging in the high-pressure element, and pressure staging at the low-pressure end. Even such a zealous advocate of the *pure* type as Parsons himself has now been converted to the advantages of this type, and is building the composite machine.

The same condition exists in the field of small machines, and it is interesting to review the various designs as mentioned by Mr. Orrok in 1909,[1] and to see which have survived the test of time and experience; and among the ones that have survived to note the modifications that have been made to suit present practice.

In the order given we find: (1) *De Laval*, (2) *Terry*, (3) *Sturtevant*, (4) *Bliss*, (5) *Dake*, (6) *Curtis*, (7) *Kerr*, (8) *Wilkinson*. These may be conveniently classed in general types as follows: (*a*) *De Laval;* (*b*) *Terry, Sturtevant* and *Bliss;* (*c*) *Dake;* (*d*) *Curtis;* (*e*) *Kerr;* (*f*) *Wilkinson.*

The Bliss, Dake and Wilkinson are either no longer on the market or are not seriously competitive; Sturtevant and Kerr still manufacture their original types only, with minor modifications; but De Laval and Terry have both recently developed machines on the Curtis principle. As these latter firms are two of the largest manufacturers of small turbines today, it would appear that there are sound reasons why they should depart from their original designs, and this fact is indicative of the general trend toward standardization mentioned above.

Since Mr. Orrok's paper, five new machines have appeared on the market. They are the Westinghouse; the Allis, Chalmers & Wait, reviving the Wilkinson principle as described by Mr. Orrok; the Lee, manufactured by the Witton Co. of New London, Conn., which is a modified Terry machine; the Alberger, an unmodified Curtis—in fact, manufactured under license from the General Electric Co., and hardly to be considered as a separate machine; the "Steam Motor," also a Curtis type, and the Moore, a modification of the Kerr machine. We have, therefore, at the present time the following types to consider: (1) The *Terry*, which includes the Sturtevant and Lee machines; (2) the *Westinghouse*, which includes the Allis, Chalmers and Wait machines; (3) the *Curtis*, which includes the machines manufactured by the G. E. Co., Terry, De Laval, Alberger, The Steam Motors Co., and Moore, and (4) the *Kerr* type, manufactured by the Kerr Turbine Co. and the Moore Co.

The machines in the first three groups employ velocity staging, and in small machines are, for the most part, single-stage, and will be considered as such for comparative purposes. Some of the designs are, of course, arranged for "staging," to improve the economy, but as this does not effect our considerations when comparing the relative merits of the general types, all machines in this class will be assumed to be of the single-stage type. The Kerr machine, primarily based on the pressure-staging principle, must be considered separately as a multi-stage machine.

As the title indicates, this paper is devoted to a purely commercial analysis of the various designs and the situation in general, and will deal particularly with non-condensing units. The thermodynamic features will be barely touched upon, except in cases where they have a direct bearing on the commercial aspect.

This paper is devoted to a commercial analysis of the four types of small steam turbines now on the market and used for the driving of auxiliary machinery, dealing principally with non-condensing units.

In these, high thermal efficiency is in many cases unnecessary on account of economic utilization of the exhaust steam, and as economy bears a definite relation to first cost, a highly efficient machine is often a mistaken investment. Moreover, operating conditions are generally such that the designer must sacrifice considerations of efficiency if they interfere in any measure with simplicity and durability.

The theoretical design, according to the author, presents no difficulties, but the mechanical design is what determines success or absolute failure; and some of the problems involved and the methods that have been employed in solving them successfully are indicated.

The average specification calls for very rigid guarantee as to steam consumption, speed regulation and load requirements that, in the opinion of the author, are in most cases unnecessarily severe and merely tend to increase the cost of installation. After an extended survey of the situation, he has been led to formulate a Code of Practice, given in an appendix to the paper. The adoption of this code would, he believes, bring about a reduction in selling prices, eliminate many of the unpleasant experiences which now often arise between manufacturers and customers, and thereby increase the popularity of the turbine-driven unit.

[1] Small Steam Turbines, George A. Orrok, Trans. Am.Soc.M.E., vol. 31 (1909), p. 263.

For presentation at the Annual Meeting of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York, December 4 to 7, 1917. The paper is here printed in abstract form, and advance copies of the complete paper may be obtained gratis upon application. All papers are subject to revision.

THREE ASPECTS OF THE SITUATION

There are three distinct aspects to this situation, namely:

(1) The type to be employed that will give the necessary competitive efficiency, with the lowest shop cost to the manufacturer; together with a design that will give satisfaction to the customer after installation.

(2) The aspect from the salesman's and customer's point of view. This governs the rating or maximum output of the machine, standardization of specifications, etc., as well as the proper appreciation of efficiency, with its relation to first cost. This latter phase is, perhaps, better explained by stating that in many instances water-rate efficiency can be economically sacrificed in favor of first cost, and vice versa.

(3) The policy of the manufacturer who builds one part of the apparatus (such as the turbine) toward the manufacturer of the other (such as the pump), and their united policy toward the customer.

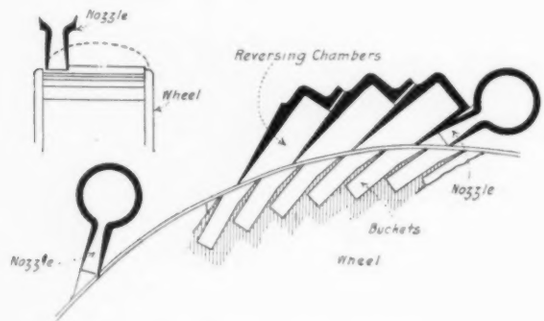

FIG. 1 TERRY TYPE TURBINE

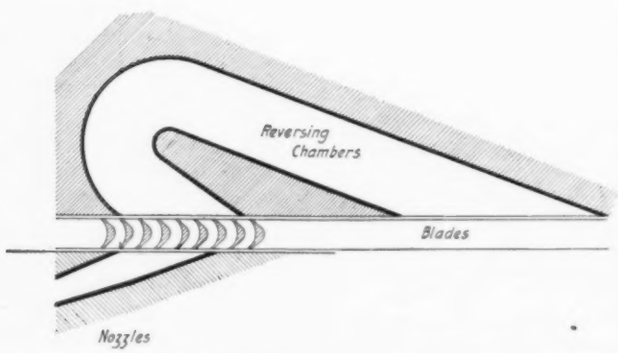

FIG. 2 WESTINGHOUSE TURBINE

[The paper here enters into a detailed consideration of the three aspects. The introduction to the author's discussion of type for efficiency, being necessarily of a mathematical nature, is not abstracted here, but only his conclusions given. His treatment of the second and third aspects is here given practically in full.]

CONSIDERATION OF TYPE FOR EFFICIENCY

It is now generally acknowledged that from a design standpoint the small machine must be laid down on a totally different basis to the larger machines. The principal reasons for this are:

a High thermal efficiency is in a great many cases unnecessary on account of the economical utilization of exhaust steam; and as economy bears a definite relation to first cost, a highly efficient machine is often a mistaken investment.

b The class of labor employed in the average station to look after auxiliaries is very inferior to that employed on the main engine-room floor. These machines, which are called upon for continuous operation, are often located in places where no other well-finished piece of machinery would be expected to run.[1] The designer must therefore consider simplicity and durability first, with as high an efficiency as possible; but he must sacrifice efficiency if in any measure it will interfere with the first essentials mentioned.

While the small-turbine auxiliary has all the appearance of a very elementary and simple engineering proposition, this is by no means the case, as any manufacturer knows; and problems equally complex with those confronting the designer of large machines have had to be solved, and a great many are by no means solved yet. We have only to consider the comparatively few firms that are competing in this line today with the number that have entered it, evidently tempted by the apparent simplicity and big profits, and finding out too late that it is a more difficult proposition than appears on the surface. The theoretical design, that is, the proportions of nozzles, blades, wheels, etc., presents no difficulties, but the *mechanical design* of such parts as the bearings, glands, governor, etc., is what determines success or absolute failure.

It is not within the province of this paper to go into these details any further than to point out in a general way some of the problems that have had to be solved. Among the more important of these are lubrication, packing and regulation.

Forced lubrication being impracticable in small machines for general-auxiliary purposes, the ring-oiled type has been called upon to operate with duties previously considered impossible, and to operate continuously with a bearing-box temperature in the neighborhood of 250 deg. fahr.

Glands or stuffing boxes are sometimes called upon to pack against a back pressure of 120 lb., while 20 and 30 lb. are common. It must be borne in mind that the soft-packing stuffing box as used in reciprocating machines is impracticable in turbine work on account of the high rubbing speeds.

The design of a satisfactory governor, the essential feature of which is simplicity, but, having a characteristic approaching the more elaborate types, has presented many difficulties; so has the governor valve, which must be as small as possible to minimize cutting at light loads, but must not crowd or stick when it is passing the maximum amount of steam required.

The above constitute the essential components governing details of the performance of the turbine itself, but there is one other and a vital factor to be considered, and one that comes directly within the present subject matter—the satisfactory performance of the whole unit. As in all other classes of machinery, certain mechanical troubles will always arise from time to time, but it is safe to say that today the general behavior of a turbine unit will compare very favorably with that of any other piece of apparatus in a power house. But to return to the more general considerations of the unit as a whole, there are some very important factors to be taken into account that are peculiar to this class of apparatus, and which have a direct bearing on the general design.

The most important of these is, of course, the necessity for true alignment. Where the unit is built in one shop the designer has a distinct advantage, inasmuch as he can so design

[1] Several cases are on record where machines have actually run for considerable periods under water without damage.

both ends of the apparatus as to make one rigid unit; but where the two ends of the unit are built by different parties it is a different proposition.

The average so-called flexible coupling will not satisfactorily take care of mis-alignment, the bedplate cannot be commercially designed that will stay true from test floor to foundations, so that no matter what care has been taken in the shops, a realignment after erection becomes an unfortunate necessity in even the smallest units. There is an extensive field for improvement in general design to eliminate this. Various schemes have been advanced recently resulting in a marked improvement in this direction, such as the 3-point support, and the 3-bearing unit with the elimination of the flexible coupling. The latter is practicable where one firm builds the whole unit, but otherwise up to the present it has not worked out very satisfactorily. The main reason for this is best explained in the case of electric-generator units. If the turbine maker takes away one of the generator bearings, in other words, disturbs the assembly of the complete generator as shipped from the manufacturer, he disclaims responsibility for anything that may happen to that part of the apparatus on the road.

In blower work the proposition is more practicable, but only when the unit is lined up by the turbine maker or one equally appreciative of the necessity of accurate workmanship.

To overcome this trouble, the Steam Motors Co. have recently placed on the market a design of machine as shown in Fig. 5. This machine is supplied with only one bearing and solid coupling for connecting to the driven apparatus. By taking a standard pump or blower and removing one bearing and fitting a solid coupling to the shaft, the combination of steam motor and pump becomes a 2-bearing unit, with a very much shorter bedplate and the elimination of any mis-alignment troubles.

In larger machines, one of the most pleasing in effect and at the same time most radical departures made in recent years to overcome the difficulties of mis-alignment, was the introduction by Mr. R. H. Rice, Mem.Am.Soc.M.E., of the General Electric Co., of the so-called rigid-frame design. From Fig. 6 it will be seen that the bedplate has been entirely eliminated, and the whole structure so designed that both ends are bound to stay in line irrespective of foundation conditions, so reducing the personal equation in erection to a minimum. In erecting this machine only one end is anchored, as shown in Fig. 6. The generator end is mounted on a sliding key, allowing free movement endwise, and on a narrow transverse foundation plate on which the generator can rock to compensate for any vertical movement of the turbine due to varying temperature. In effect, the machine rests on its foundations, as shown diagramatically in the figure.

THE SALESMAN'S AND CUSTOMER'S ASPECT

What might be called the truly commercial aspect of this situation, i.e., those phases of vital interest to the salesman and customer, presents many interesting problems. To begin with, we must forget that we are dealing with steam turbines in the sense that we have been accustomed to, when we have only been considering prime movers. For auxiliary purposes the small turbine is becoming the standard method of drive. That means that it is getting into the class of the electric motor. It has already passed the stage of being "built," and is now being successfully manufactured in quantity.

There is, however, still a great deal to be accomplished before the machine can be satisfactorily manufactured to be sold from stock. At first sight it might appear that this is almost out of the question, especially when we see such a diversity of specifications as accompany the average contracts for small turbines today, but when the number of these machines that are now being turned out at the present time and the fact that the market is increasing rapidly are considered, it is surely only a matter of time when some form of standardization will be absolutely necessary. In the electrical industry we have seen the wonderful advantages, both to the manufacturer and customer, of the rules laid down by standardization committees, and we wondered why we had not adopted them

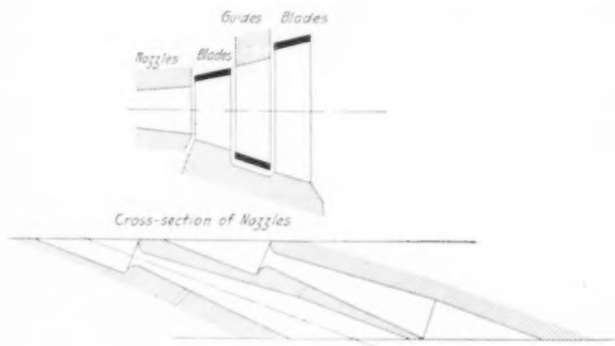

FIG. 3 CURTIS TURBINE

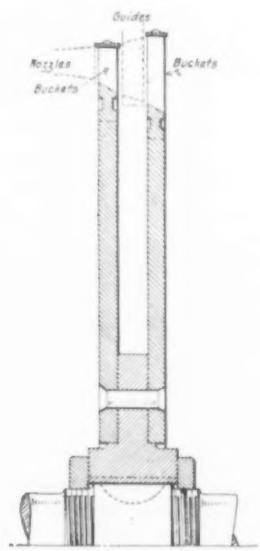

FIG. 4 KERR BUILT-UP WHEEL

sooner. Perhaps not to the same degree of perfection, but certainly to some extent a standardization of small-turbine specifications is not only possible but quite practicable. As long as the customer calls for something special and everybody is willing to build it, not only does this customer have to pay for it, but the standard machine will cost more on account of the interruption to the manufacturer in putting through lots.

Let us then consider where the possibilities lie in this direction, analyzing the various requirements of the average specification which call for rigid guarantees under the headings: (*a*) steam-consumption guarantees at certain loads with fixed or various steam conditions; (*b*) speed-regulation guarantees,

and when connected to electric generators voltage-regulation guarantees in addition, and (*c*) various load requirements with varying steam- and back-pressure conditions. In addition there is a diversity of requirements as to fittings, such as water-pressure regulator, emergency governor, strainer, etc.

Regarding (*a*), this is a much-debated point when discussing small turbines. Granted there was a time when the small turbine was very wasteful of steam, that time has nevertheless passed, and the builder of small turbines today meets any guarantee he makes; and at the very worst it is questionable whether a small turbine was ever built that consumed steam at a rate comparable with some direct-acting pumps. But there was never any serious criticism raised with such pumps on that score, nor was the manufacturer even asked for a guarantee. The consulting engineer or purchaser feels that he cannot possibly buy a steam turbine, no matter how small, unless he imposes numerous stringent guarantees as regards steam consumption. The fact that an auxiliary rarely operates under

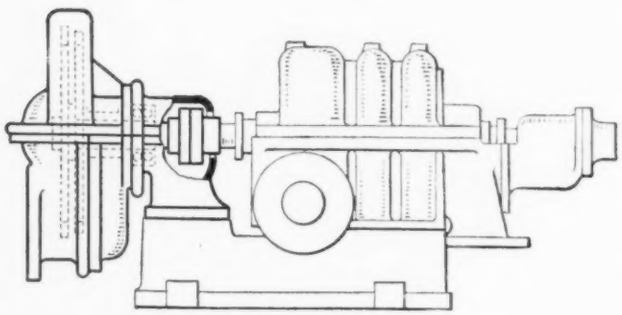

FIG. 5 PUMP AND OVERHUNG TURBINE

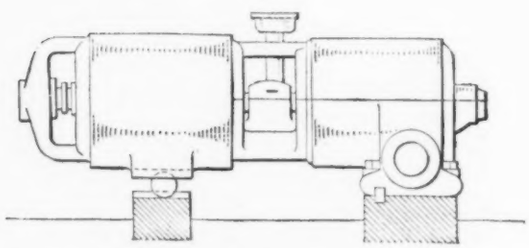

FIG. 6 RIGID-FRAME DESIGN TURBINE AND PUMP

the steam conditions as specified, and therefore the guarantees as made bear but little relation to the actual performance, does not enter into his consideration at all.

When a manufacturer advances any argument relative to the unimportance of steam consumption, he is generally misunderstood. The customer feels he is trying to evade any responsibility along these lines and sell an inferior piece of machinery. Let us look at that from another standpoint. The manufacturer today builds one line of machines. There are so many cases where efficiency is of prime importance that the machine as built must be capable of meeting the guarantees as demanded by the market. Furthermore, any machine with a witness-test clause added on cannot be put through the shops independently, but must necessarily be one of a lot of identical machines. If this machine meets its guarantee on test, it is only fair to assume that the others cannot be far off the mark. In this connection, a concern regularly manufactures machines for the U. S. Government under specifications that are most rigid as regards performances on test, yet, with the possible exception of material inspection in some cases, these machines are standard in all respects.

Witness tests are costly. The manufacturer naturally cannot notify the customer exactly when a machine will be ready for the shop tests, and would not want him present then if he did, so that any delay in a busy shop awaiting the customer's convenience and a duplication of the tests must eventually be paid for directly or indirectly by the purchaser.

One more word on the absurd multiplicity of guarantees sometimes called for. It is no exception to find in some propositions, particularly from pump companies, a request for 15 or 20 guarantees under different conditions for a non-condensing machine where the exhaust is to be used in the feedwater heater.

Clause (*b*), speed-regulation guarantee, is necessarily of vital importance in such work as generator drive, but it surely is of no importance whatever when the speed of the turbine is primarily governed by a pressure regulator as in the case of a boiler-feed pump or forced-draft set controlled in a similar manner, yet the manufacturer has to religiously put in his 2 per cent clause.

Even with generator drive, the average clauses are too exacting for the good of the customers. Why need we specify a close speed variation when we already specify a certain variation in voltage? The compensated-wound generator can give flat compounding with a big speed variation, and a reasonably large speed variation means stable governing, whereas a sensitive governor means instability and a tendency to hunt. We have only to look at the average a-c. machine to realize how essential a reasonably wide speed variation is for satisfactory parallel operation.

Again, to obtain close speed variation on test means very delicate fitting and adjustment of the governor valve. The valve must shut absolutely tight, and any valve built this way is subject to cutting in service; whereas, if a wider speed variation had been permissible in the first instance, a more durable valve could have been installed.

Regarding (*c*) load requirements, there is a strong tendency to introduce the *maximum rated* standard into the small-turbine field, and common sense tells us that it is the only proper competitive basis; but is the adoption of this standard commercially practicable under existing conditions? As far as the turbine itself is concerned there is no argument, the output can be accurately estimated; but does the same degree of certainty exist among the pump and blower makers?

With the repeated changes in design, the limited testing facilities in the average pump-maker's plant and the almost impossible proposition of making accurate blower tests on a commercial basis, is it feasible at the present time to order a turbine without an overload margin to take care of errors that are not only excusable but are to be reasonably expected? Experience tells us that a certain leeway *is* necessary. The turbine maker knows this, and often finds that the addition of another jet, over and above that necessary to meet the contract, is a good investment. This principle is not right if we are to have fair competition among turbine makers; it is only natural that the pump maker will favor the type of machine that *he knows* will give him a good big overload. The worst feature of this situation is the fact that in some cases in a cut-price job the pump maker has *relied* on the overload capacity of the turbine to give full load at the pump.[1]

[1] A representative of a pump manufacturer was once frank enough to admit that a certain turbine firm always got the preference because it was more liberal with its overload capacities.

The adoption of the maximum-rating standard by *all* turbine makers and their rigid adherence to it would, in a great measure, solve this whole problem. Granted that allowances are necessary, they should all be made by the pump or blower maker, who should be the best judge as to the leeway advisable, and he should order his turbine accordingly.

The question as to whether the maximum rating will be satisfactory to the customer is another matter to be considered. With the customer educated to the limitations of the turbine there should be no difficulty; but as long as he thinks it can be loaded up to breaking-down point like a motor, there will be dissatisfaction if the machine fails to carry full load when the steam pressure drops. All that is necessary in this case is a clear understanding between the contractor and purchaser as to the conditions *necessary* to obtain full load.

It might be well to bring out here an important point in connection with non-condensing auxiliaries that run at full load continuously. With a condensing machine considerable variations in initial steam pressure can take place without materially affecting the output, but in a non-condensing machine a multiplicity of small deviations from the contract conditions, each insignificant in itself, can have a very marked effect on the output, as will be seen from the following table, which compares the conditions, as they would be specified in an average contract, with conditions that could reasonably be expected in service:[1]

	Steam press., lb.	Quality.	Back press., lb.	Hp.
Specified conditions.....	150	100%	0	100
Operating conditions.....	140	98%	2	83

With a view to setting forth how the theories mentioned above can be worked out in practice, a suggested Code of Practice is given in an Appendix.

The question of steam consumption, with its true relation to the overall efficiency of the plant, has lately been receiving much more attention than formerly. In stations and industrial plants where all the exhaust can be utilized, the thermal efficiency of the auxiliaries can vary very considerably without an appreciable effect on the coal pile. Fig. 3 shows what a relatively small effect a very large range in water rate has on the heating value of the exhaust steam.

However, in stations where there are times when all the exhaust cannot be economically utilized, the question of the auxiliary efficiencies becomes of serious importance. To meet this condition a great many radical changes have been made in the general layout of this part of the apparatus, particularly in the introduction of gear-driven pumps, etc., in place of the low-speed, direct-connected type. Any innovation of value here naturally means complications, in the same manner that any marked improvement in the steam consumption of the turbine itself must necessarily be made at a sacrifice of simplicity. Can we afford to do this? Will the little saving that at best can be made commercially in any design of small turbine give the net result required? Is it not better to accept the best efficiency conducive to maximum simplicity and reliability, and be content with that; then, when the point is reached where more exhaust than that supplied by a certain number of auxiliaries is required, to switch over to electrically driven apparatus? The combination steam- and electrically-driven unit meets this situation admirably.

[1] In this connection it might be well to enlarge on one point often overlooked by the manufacturer and customer alike, the necessity for very liberal allowances in machines operating at very low pressures. Operating with atmospheric exhaust an initial drop in steam pressure of 10 lb. from 150 lb. means a reduction of available B.t.u. at the turbine of 3 per cent, whereas the same drop at 60 lb. (common in sugar refinery work) means over 10 per cent. Therefore velocities permissible under the higher pressure must be considerably cut down when it is desired to maintain full load at around 60 or 70 lb.

The ideal way to distribute the units would be to begin with the turbine units in all places that receive the least attention, and such places as boiler-feed pumps, that must not be shut down in case of any electrical disturbance, and keep the electrically driven units on the main engine-room floor as far as possible.

THE MANUFACTURER'S POLICY

Regarding the question of policy between the manufacturer of the respective parts of a complete piece of apparatus and the combined policy of manufacturers toward the customer, the first question that arises is why should there be any difference here from the policy adopted in other branches of the trade. Theoretically, of course, there should be no difference, but many conditions, unfortunately, exist, peculiar to this business, that make this question of policy a very vital one and worthy of serious consideration in any attempt to solve the commercial problem under consideration. When an engine-driven or motor-driven set is sold, the correspondence between the respective manufacturers consists of an interchange of formal orders; but we have a long way to go before we arrive at the same businesslike procedure in connection with turbine units.

These arguments, of course, do not concern the builder of the combined unit, who in this respect will always have a distinct advantage over the other manufacturers.

Any standardization along the lines suggested above will do more than anything else toward clearing the atmosphere of such questions as the limitations of apparatus furnished, the long interchange of correspondence relative to unimportant partial-load performances, and the responsibility for imperfect erection at the customer's plant.

Our one idea in all these considerations is the ultimate reduction of factory costs. Selling costs do not enter into this argument. Factory costs consist of two essential items—manufacturing expenses and overhead. Standardization and the elimination of special machines will help our shop costs or manufacturing expenses. The next question is, What can be done to reduce overhead expenses? To the layman it would appear that the latter should consist of the merest clerical work in such a simple apparatus as a small turbine, but there is today, in addition, a very heavy expenditure that must be borne by all manufacturers alike, and that is the maintenance of a trouble force in the engineering department at the works as well as outside, out of all proportion to the legitimate requirements of the situation. It is here where the question of policy comes in, and it is here where we can look for one of the biggest economies.

There is a deplorable lack of coöperation existing at the present time between the average turbine builder and many of the pump and blower builders. If a unit is reported unsatisfactory for any reason after erection, and the report goes to the pump builder, he will almost invariably assume the said trouble is entirely the fault of the turbine, and call upon the turbine maker to send a man to remedy it before he makes any investigation as to the performance of his own apparatus, and vice versa, if the original report goes to the other party. Even at the station it is common practice for the representative of one end of the apparatus to go out of his way to explain to the customer in detail how the trouble is entirely up to the other end, and this state of affairs is by no means confined to the erecting staff, who cannot always be blamed for taking this attitude, but to the higher officials of the company, who ought to know better. This state of affairs does not help

the customer, but it goes a long way toward making him buy his next machine from a firm manufacturing the whole unit. This condition may, to a certain degree, be expected, but surely it is possible to formulate some definite line of procedure that will, in a great measure, relieve this present unhealthy situation.

One of the prominent obstacles to the application of any hard and fast rule is the fact that firms cater to the larger corporations, and feel that it behooves them to go to unjustifiable expense in case of trouble to keep in their good graces for future business. A sound and uniform policy on the part of all manufacturers would put each one in a much stronger position.

A few suggestions as given below present themselves at this time, each one of which, if adopted by one or two individual firms, would probably result in serious disaster, but if conscientiously adopted by all firms would undoubtedly have a mutually beneficial result.

If a turbine is bought by a pump or blower maker, said purchaser must accept the machine on leaving the maker's works as having met all its guarantees (as in the case of reciprocating engines and motors). If, however, subsequent performance warrants a test to determine the performance of the turbine, said test must be arranged for and carried out at the expense of the purchaser. The expenses of a representative of the turbine maker, who must be present, to be included. If the tests show conclusively that the turbine has failed, then all the expenses are automatically transferred to the turbine maker, and he is to be allowed, say, two months to remedy the faults of his apparatus before rejection.

If a test on sight is impossible, the maker can demand that the machine be returned to the works, where a witness test can be made in the presence of the purchaser's representative, the purchaser paying all expenses, including freight, if the machine on test is not at fault, and vice versa, as above.

Neglecting the few instances where both ends of the machine fail, there should be no such thing as dividing the expenses. The machine is right or wrong, and the responsible party should pay all. Cases are on record where a hard and fast rule of this kind would have eliminated years (not months) of controversy over the equitable division of expenses. If the respective parties cannot come to terms, then they should agree to take the decision of an arbitrator mutually agreed upon. As soon as any controversy arises his services should be sought immediately, and not as at present (when this course has been adopted) after months of expensive haggling, with the resulting hard feeling that this invariably creates.

If the customer disputes the performance of the whole outfit, it rests with him to conduct the necessary tests at his own expense, with the same adjustment of costs as above, the makers' engineers to be invited to all such tests.

In all cases of trouble, the customer must first of all see to it that he notifies the right party, i.e., the master contractor. If the turbine breaks down, and the unit is bought from a pump maker, it is primarily the duty of the pump maker to apply the remedy. All dealings with the customer must be through him. Again, if a machine is bought F.O.B. factory from a reputable concern, and trouble is experienced after erection and the services of an expert are requested, the request should be sent by a responsible member of the purchaser's firm, and be considered in the light of a formal order covering said expert's expenses. If the trouble is due to defects in the apparatus, the manufacturer cannot send in a bill and expect any repeat orders.

One of the hardest propositions the manufacturer is confronted with today is to collect for expenses when the trouble has been entirely due to the engineer's absolute neglect of the instruction book furnished with the machine, or other cause for which the manufacturer should in no way be held responsible. If all makers could see their way to adopt a policy of this kind, requests for men by irresponsible under-engineers would rapidly decrease. The fact is that if the engineer knows at the outset that if the trouble is caused by his own negligence and the expense is going to be charged against him, he is naturally going to make sure of his ground before he risks the displeasure of his superiors by showing his incompetence to adjust the machine, or runs up unnecessary bills in his department.

In like manner the subcontractor must expect a formal order from the master contractor for any expert services.

In conclusion, this is not a matter that concerns only the manufacturer from a financial standpoint. It concerns the purchaser, inasmuch as the selling price of the apparatus will be reduced. It also concerns the manufacturer from the standpoint that any advance along the lines suggested cannot have any other effect than to eliminate unpleasant experiences with the customer and thereby increase the popularity of the turbine-driven unit.

The Second Industrial Safety Congress of New York State will be held at Syracuse, N. Y., from December 3 to 6, under the auspices of the State Industrial Commission. Some of the topics to be considered are Safety from an Economic Standpoint as Well as a Humanitarian Proposition, What Part Does Labor Play in the Safety Movement? Disciplining Careless Workmen—How the Employer Feels About It and How the Employee Feels, and Safety Committees, Their Scope and Benefit. The headquarters of the congress will be at the Hotel Onondaga.

Suggestions addressed to owners and managers of power plants for the economical use of coal have been prepared by the Committee on Coal Conservation of the Chamber of Commerce of the United States, which is working in conjunction with the Council of National Defense. The cost of coal for the generation of power, the committee points out, has in many instances not had the same consideration as other costs because coal has been cheap and abundant, so that cheap coal and cheap labor sometimes made it apparently economical in dollars and cents to install and operate an inefficient plant. Coal and labor are now expensive and conditions make it imperative for every owner or manager of a power plant to examine into the cost of the power his establishment uses, the economy with which it is generated and applied and the increase in efficiency that is possible.

Most users of coal can join in promoting efficiency of coal. Railways have made real progress in firing locomotives; they can often go farther. Gas workers can generally effect further saving by using careful technical direction. Manufacturing plants of every degree can show great results in the aggregate.

The Bureau of Mines, on behalf of the Federal Government, has gathered a great deal of information about the use of coal and has expert advice to give regarding means of economy. Several publications, in which the Bureau of Mines has embodied the results of its experiments and made practeal suggestions based upon expert observations and conclusions of its staff and other engineers, are now available and a list can be obtained by application to Director Van H. Manning.

RECENT DEVELOPMENTS IN BALANCING APPARATUS

By N. W. AKIMOFF, PHILADELPHIA, PA.

Member of the Society

Improvements have been made by the author upon the balancing machine described by him in a paper presented before the Society in 1916. They are based mainly on a revision of his former method for securing static balance in a body used as a step in the process of determining its dynamic balance. Two formulae are given to show mathematically the lack of precision in ordinary methods for obtaining such static balance.

The author uses a clamp attached to the body to be balanced, whereby a centrifugal force is introduced when the body is rotated, for the purpose of neutralizing the static or dynamic unbalance of the body. By suitably constraining the motion of the rotating body, either the static or dynamic unbalance, or the combination of both, may be accurately measured through the adjustment of the clamp.

SINCE my paper was presented on the subject of Dynamic Balance,[1] certain improvements have been made in the machine there described; and an entirely new machine based on new methods of balancing has been developed.

The principle of the original machine is indicated in Fig. 1, which shows a lathe bed which takes the form of a beam hinged at one end and supported by a spring at the other. The body to be tested must first be brought into static balance, after which it is rotated in bearings supported by the beam. If the body is dynamically unbalanced its rotation will cause the beam to vibrate in a vertical plane with a period of oscillation equal to the period of rotation of the body.

Suspended from the beam is a second body in the form of a so-called squirrel cage consisting of two circular disks carrying an even number of rods so arranged as to slide in holes in the disks. The cage rotates in unison with the body to be tested and a state of unbalance in this body introduces a centrifugal couple which is neutralized by displacing the rods in the cage until an equal compensating couple has been introduced. The distances that the rods are displaced serve as a measurement of the amount of unbalance to be provided for and counterbalanced in the piece under test.

The improvements upon this original machine, referred to above, are as follows:

a The substitution for the cage of a two-point element consisting of two disks, A and B, each with a pin projecting from its face, as shown in Fig. 2. The disk A is fixed to its shaft and the disk B is arranged to slide on the shaft through the use of a feather key f. It is clear that when the two disks are in contact they will balance each other; but when separated they will introduce a certain centrifugal couple according to the weight of the pins and the distance between the disks, which latter can be varied while the apparatus is in motion.

b A planetary arrangement by which the relative angular position of the body and the disks (or cage) can be varied while the machine is in operation.

c The application of a principle whereby the disks (or cage) may be arranged to answer the problem of static balance as well as dynamic balance.

The new methods which have been developed and applied in a new type of machine for combination static and dynamic balancing will be referred to later.

STATIC BALANCE

As a result of a great deal of study of the problem of static balance, I have been forced to admit, in common with many other engineers, that too much has been taken for granted in relation to this subject. Static balance is not a trifling problem to be solved easily by placing a rotating body on parallel ways or rollers, as has commonly been supposed. While it is true that static balance can be found without much trouble in the case of bodies of light weight or where the operating speeds are comparatively slow, there are other cases which are much more difficult. For example, consider a gyroscope wheel whose weight is about 50 lb. or so, running at, say, 10,000 r.p.m.; or a turbo-rotor whose weight is 10,000 lb. and whose speed is 3600 r.p.m. Neither of these extreme cases can possibly be handled with any degree of success by placing the bodies on ways; and yet, unless static balance is perfect, no dynamic balancing machine can be expected to give reliable results.

STATIC BALANCE BY MEANS OF PARALLEL WAYS

It may be well to point out that in balancing by the aid of parallel ways there is a limit to the load which can be safely borne by the journals in contact with the ways. A safe load for each journal appears to be 750 lb. per inch of width, per inch diameter of journal.[1] For instance, if the ways are 1½ in. wide and the journal diameter is 10 in., then each side will carry almost 12,000 lb. without any danger of forming permanent flat spots.

It would be of interest if one could estimate the sluggishness of action of a body on the ways under different conditions. The older theories of rolling friction, as proposed by Coulomb, Morin and Dupuit, do not seem to lead to very reliable results. Résal's formula[2] is probably much more reliable and is here reproduced in simplified form (steel on steel):

$$f = 0.056 \sqrt{1/(1 + 79/D)}$$

where f is the length of the flat contact of shaft with the way and D is the diameter of shaft, both in inches. It appears that

[1] New Orleans meeting, 1916; Transactions Am.Soc.M.E., vol. 38, p. 367.

For presentation at the Annual Meeting, December 1917, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 West 39th Street, New York. All papers are subject to revision.

[1] According to the writer's remembrance, this figure was first given him by the engineers of the Standard Roller Bearing Co. many years ago, and has since been revised by him in connection with other practical data which he was able to gather from different sources.

[2] Résal, Traité de Mécanique Générale, T. 11, p. 6.

the weight does not enter into the formula, and in general its results should not be considered as extending to extremes, but only as characterizing the average run of things as they are met with in practice.

The diagram in Fig. 3 has been roughly plotted to illustrate the probable *sluggishness* or *residual unbalance* which *may* remain in a body that has been brought into apparent balance by testing on ways. The chart is based on Résal's formula, and, as it is intended simply to illustrate the meaning of the formula, values have been exaggerated by plotting shafts of small diameter against weights altogether inconsistent there-

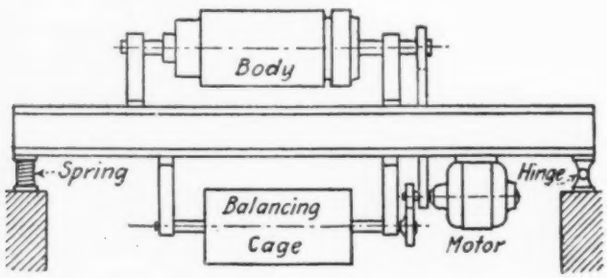

FIG. 1 SQUIRREL-CAGE TYPE OF DYNAMIC BALANCING MACHINE

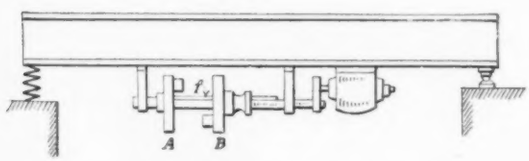

FIG. 2 TWO-POINT BALANCING ELEMENT

with. The chart is easily read: for instance, if a rotor weighs 4000 lb. and diameter of its shaft is 6 in., then the residual unbalance may be as great as 480 ounce-inches, or say, 2½ lb. on a 12-in. radius. It is useless to put a body statically unbalanced to such an extent (or even to 50 per cent of this) on any dynamic balancing machine. Satisfactory results cannot possibly be derived from such tests. An actual case of residual unbalance, typical of many others, is of a shaft having a diameter of $2\frac{3}{32}$ in., a weight of 66 lb. and a residual unbalance of 0.844 ounce-inches. The width of the balancing ways was $\frac{5}{16}$ in. (cast iron chilled and ground).

Considering the phenomenon of rolling friction from the standpoint of higher theories of elasticity (Hertz), the following tentative formula was derived for residual unbalance:

$$M = 0.0004648\, P \sqrt{PD}$$

where M is the residual moment in ounce-inches, P the weight per unit of contact length (that is, per inch of combined width of ways), and D the diameter of shaft in inches (steel on steel). The constant may be considered to be rather tentative, but with the advent of a machine capable of establishing perfect static balance it will not take long to find more reliable values for it.

According to this formula, if an armature weighed 12,000 lb. and had a shaft diameter of 8 in., the sluggishness or residual balance when placed on ways 1 in. wide, would be:

$$M = 0.0004648 \times 6000 \sqrt{6000 \times 8} = 614 \text{ oz-in.}$$

or over 3 lb. on a 12-in. radius. At 3600 r.p.m. the centrifugal force due to such residual unbalance would be more than 14,000 lb.

USE OF CENTRIFUGAL FORCE IN BALANCING

As previously stated, my earlier machine for dynamic balancing was based on the introduction of *centrifugal couples*, created by the operator to offset the effect of the disturbing centrifugal couple, constituting unbalance in the rotating body. Likewise, a machine for static balancing can be based on the same principle, but long study of the subject has led me to the conclusion that the whole problem of balance, static and dynamic, can be reduced to the principle of a single *centrifugal force* acting on a properly constrained body. Such centrifugal force can be created by the operator, within a rotating body, by such means as, for instance, the clamps of which two designs are here shown (Figs. 4 and 5). As will be explained, such clamps may be used to offset the effect of static or dynamic unbalance in a rotating body, as the case may be, and to record the extent of such unbalance. They should be carefully made and so calibrated that the centrifugal force may be given as a function of some linear dimension, read directly or measured by an accurate scale. The first clamp is easier to make and check for accuracy; while the second design is much handier for quick adjustment on the shaft of a rotating body.

MEANS FOR SECURING STATIC BALANCE

In order to register the effect of static unbalance of a body, or the correction introduced by means of such a clamp as described, the body must be placed in such a condition that its oscillations are emphasized or magnified to an extent that will be visible to the eye; otherwise its unbalance, even if considerable, will not be noticeable and will only result in

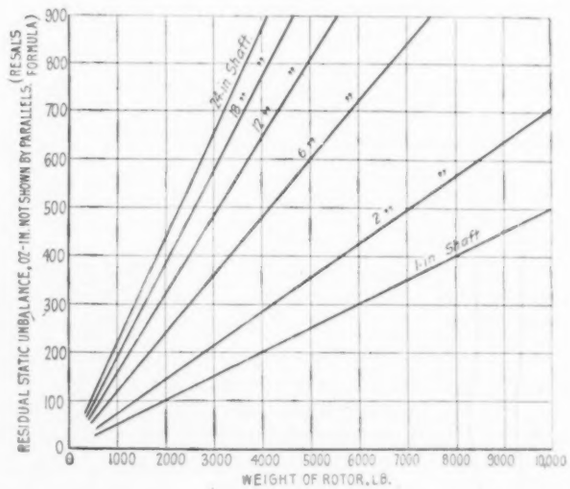

FIG. 3 PROBABLE RESIDUAL UNBALANCE OF BODIES BALANCED ON TESTING WAYS

increased pressure on the bearings. Thus, in a badly unbalanced automobile engine, it is most often possible to pick out a range of speeds where the engine will appear to work smoothly; and many an electric motor with badly unbalanced rotor will apparently run well, simply because its speed may be far away from that which would insure synchronism of the rotation with the oscillation of bearing supports.

Now, suppose we have a frame, suspended as shown in Fig. 9, and capable of a certain period of swinging oscillation. If the body, statically unbalanced, is operated at a speed corresponding to the period of oscillation, the oscilla-

tions of the frame will become violent, and can be readily registered by any suitable dial-gage indicator. Here the body is imposing its own period on the frame, which thus performs what are known as forced vibrations of the same period. Our task is then to adjust the speed of the body so that the period of such forced oscillation will be equal to that of the natural oscillation of the frame and body (at rest).

enough to see that a clamp k can always be so adjusted, both angularly and as regards its off-center position, so as to nullify the oscillations of the frame, thereby solving the problem of static balance. No matter how heavy the body, it is always possible to place it into most minute balance by this method, where ordinary parallels would be altogether inoperative.

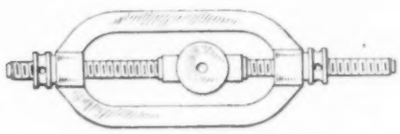

FIG. 4

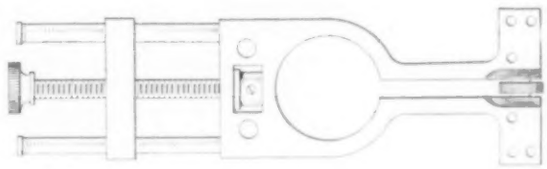

FIG. 5

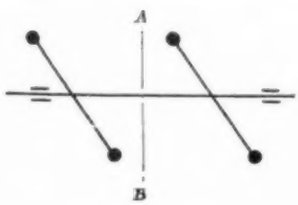

FIG. 6

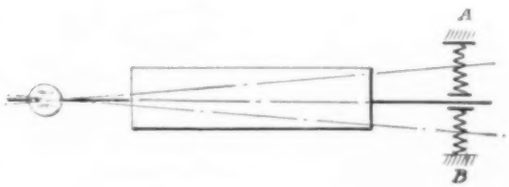

FIG. 7

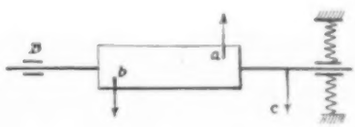

FIG. 8

FIGS. 4 AND 5, CLAMPS USED IN SECURING STATIC AND DYNAMIC BALANCE; FIG. 6, UNBALANCED BODY WITH CENTER OF GRAVITY LYING IN ITS AXIS; FIG. 7, ONE BEARING PIVOTED AND ONE FLOATING; FIG. 8, CENTRIFUGAL COUPLE BALANCED BY A CENTRIFUGAL FORCE.

In Lord Rayleigh's remarkable book[1] a most lucid explanation is given of this phenomenon of "step" or synchronism.

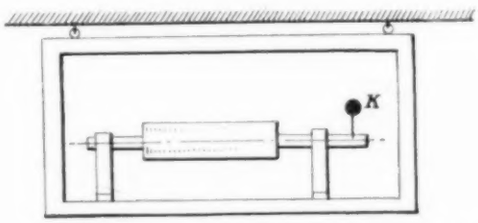

FIG. 9. BODY SUPPORTED IN SWINGING FRAME FOR SECURING STATIC BALANCE

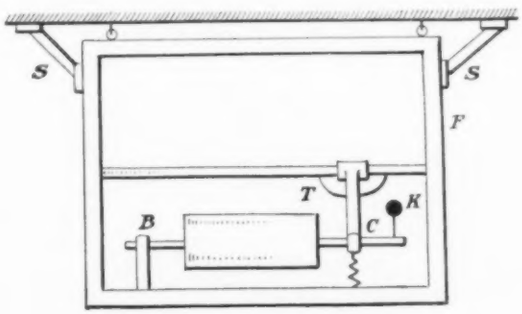

FIG. 10 BODY WITH ONE FLOATING BEARING, SUPPORTED IN RIGID FRAME FOR SECURING DYNAMIC BALANCE

Lord Kelvin's well-known device called a "vibrometer" is likewise based on this very principle. Of course, it is easy

DYNAMIC BALANCE

As regards dynamic balance, due, in a statically balanced body, only to the presence of a centrifugal couple, the following remarks can be made: In the first place the "theory" that this centrifugal couple is due to the fact that the centers of gravity of both halves of the body, cut through its center of gravity, do not lie on the axis of rotation, is radically wrong. Take for instance a skeleton body shown in Fig. 6. Its center of gravity is exactly on the axis of rotation, as also are the individual centers of gravity of each half, to the right and to the left from A to B. Yet such a body would be manifestly out of balance (dynamically). Inversely, a body would readily be imagined to be both in static and dynamic balance, although each of its *halves* were statically out of balance. The only correct way to characterize dynamic balance is to say that the *products of inertia*, containing the axis of rotation, vanish[2]; or, to put it practically, that there is no centrifugal couple in any axial plane.

In the next place, if we constrain (pivot) one end of a rotating body (statically balanced but dynamically out of balance) while the other end is arranged to float in a bearing supported by springs so that it may move, say, in a horizontal plane, Fig. 7, then the oscillations of the body will be angular, as from A to B. Under these conditions the observer will be unable to tell whether the vibrations are due to a *force* (centrifugal) acting somewhere on the body or to a centrifugal couple, unless he knows beforehand that the body is in perfect static balance, under which conditions the vibratory effect can be due only to dynamic unbalance. This being the case, in

[1] Theory of Sound.

[2] Slocum, Theory and Practice of Mechanics, p. 297.

view of the reaction of the constrained end, it is perfectly possible to balance the effect of a centrifugal couple by means of a centrifugal *force*. Thus, in Fig. 8, if it is assumed that the dynamic unbalance is due to the couple *a-b*, it will always be possible to select a centrifugal force *c*, such that it will quiet the vibrating body, and because of its known distance from the bearing *B*, establish the exact value, sign and angular position of the disturbing centrifugal couple *a-b*.

It is thus clearly seen that it is possible to utilize a centrifugal force to good advantage in finding both static and dynamic unbalance of bodies; and combining the principles illustrated in Figs. 7 and 9, we have a combination static and dynamic balancing machine, of which the scheme is as follows:

DESCRIPTION OF IMPROVED BALANCING MACHINE

A frame *F*, Fig 10, supports the bearings *B* and *C*, which carry the body. The frame has a swinging period of its own. The bearing *C* may either be locked, so that it acts exactly like the rigid bearing *B;* or else it may be allowed to float in

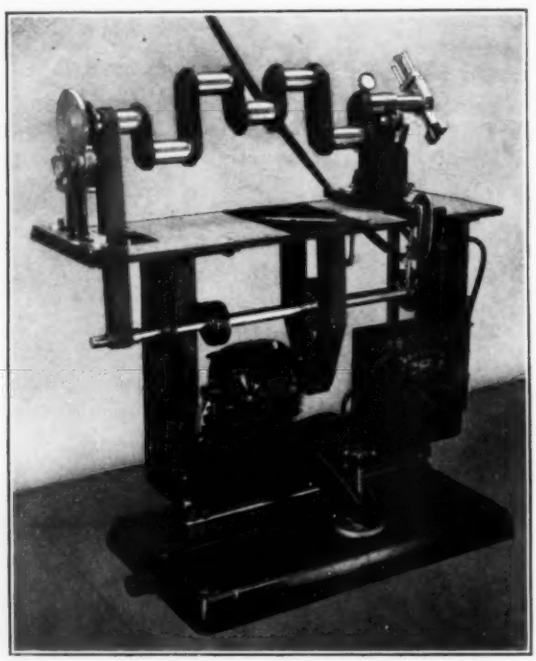

FIG. 11 COMBINED STATIC AND DYNAMIC BALANCING MACHINE

a vertical plane, bringing into play certain resistances (springs) opposing its deflection from the neutral (vertical) position. The correcting centrifugal force is indicated by *k*.

Such a system is known in dynamics as a *system with two degrees of freedom*, in general being capable of two kinds of motion: swinging of the frame, the bearing *C* being maintained rigid; and swinging of the bearing *C*, the frame *F* being maintained rigid by such means as brackets *S;* while the most general motion consists of a combination of these two motions.

The operation of such a combination machine is very clear. In order to secure static balance we lock the bearing *C* and unlock the frame supports *S*. Then, by properly adjusting the magnitude and direction of *k* we can reduce to zero the bodily oscillations of the frame *F*, thus establishing the exact value and sign of static unbalance in ounce-inch units. As soon as this has been corrected, we lock the frame *F* and unlock the bearings *C*, when the same centrifugal force *k*, created by a suitable adjustment of the clamp as explained above, can be made to correct the body for dynamic unbalance, as illustrated in Fig. 7. The advantage of basing the results on the centrifugal force instead of on a centrifugal couple is manifest, the former being a *fundamental*, and the latter a *derived*, unit, so that the former is capable of much greater accuracy in adjustment and of more direct application than the latter.

Fig. 11 illustrates a balancing machine built in accordance with the scheme of Fig. 10. The yielding support, clearly shown on the right, has means for easy adjustment of its period, as likewise has the frame itself. The motor is of ⅓ hp. capacity and operates the body, through a countershaft, by a rubber belt. The balancing clamp is seen on the extreme right of the crankshaft. The oscillations are read by means of ordinary Starrett dial gages, graduated in thousandths of an inch. The precision which can be secured on such a machine is almost uncanny; it enables one to see the sluggishness of the method of balancing on ways and therefore the absolute lack of precision of dynamic balance that might be based on such results. A well-designed clamp is very easily handled and its correct position can be established in a few minutes. Its indications are capable of tabular interpretation, so that the operator has merely to carry out the simple instructions, worked out beforehand. Of course, it is clear that such a machine can be built for any size of body, or for any speed that may be desired.

Two minerals not heretofore known to science have been discovered at Crestmore, Cal., according to a bulletin issued yesterday by Prof. Arthur Eakle, department of geology, University of California. Professor Eakle has christened the discoveries respectively "crestmoreite" and "riversideite." The first is described as a new hydrous basic orthosilicate, containing small amounts of other oxides in place of silica. The latter is a hydrous lime sulphate.—*Minneapolis Morning Tribune*, October 31, 1917, p. 1.

A report on the deterioration in the heating value of coal during storage, covering a five-year period, has just been issued by the Bureau of Mines, Department of the Interior, as Bulletin 136. The tests show that the amount of deterioration has commonly been overestimated. Except for the subbituminous Wyoming coal, no loss was observed in outdoor weathering greater than 1.2 per cent in the first year, or 2.1 per cent in two years. The bulletin, of which the authors are Horace C. Porter and F. K. Ovitz, may be obtained free of charge by addressing the director of the Bureau of Mines, Washington.

Roughly, two pounds of seasoned wood have a fuel value equal to one pound of coal, according to experts of the United States Forest Service. Different kinds of wood have different fuel values, and in general the greater the dry weight of a nonresinous wood the more heat it will give out when burned. For such species as hickory, oak, beech, birch, hard maple, ash, locust, longleaf pine or cherry, which have comparatively high fuel values, one cord, weighing about 4000 lb., is required to equal one ton of coal; it takes a cord and a half (a total weight of 4500 lb.) of shortleaf pine, hemlock, red gum, Douglas fir, sycamore or soft maple, which weighs about 3000 lb. a cord, to equal a ton of coal; while of cedar, redwood, poplar, catalpa, Norway pine, cypress, basswood, spruce and white pine, two cords, weighing about 2000 lb. each, or 4000 lb., are required.—*Power*, November 13, 1917, p. 657.

EXPENSES AND COSTS

By H. L. GANTT, NEW YORK, N. Y.

Member of the Society

IN determining the cost of a manufactured article, should we include all the expense incurred while that article is being manufactured, or should we include only those expenses which contribute to its production?

It does not require any knowledge of cost accounting, bookkeeping, or other office art to enable the practical man to say that costs should include only those expenses needed to produce the article in question, and that those people who insist on including in their costs expenses which do not contribute to the production of the article are simply trying to recover from the public through a higher selling price the expenses which they incur through inefficiency and waste.

All cost figures may be divided into three parts:

a Expense for material
b Expense for labor
c Overhead expense, or "burden."

There is no great difficulty about getting the expense for material and the expense for labor, and most concerns get these elements quite accurately, but there is a great variety of opinion as to what the "burden" charge on any particular work should be. This overhead or "burden" may be divided into two parts:

a That which is incurred through simple ownership or rental of the plant and keeping it ready for operation
b That which is incurred by operating the plant, exclusive of direct labor and material.

Analyzing further the meaning of the term "burden," we see that the first part is made up of ownership or rental of a number of machines or work benches, properly housed. The second part consists of the expense of operating the various machines, which consists of such items as power, oil, waste, repairs, etc.

Inasmuch as the rental which we should pay for the plant is made up of the rental of the individual machines and work spaces, we must be able to determine the proper rental for each of these in order to form an intelligent idea of the proper rental for the whole plant. In the same way we can determine the amount of supervision, power, oil, and waste needed to run these machines individually.

Working along these lines, we are able to determine for each machine in the factory both an idle- and an operating-expense rate.

Any article manufactured on a machine should undoubtedly bear the operating-expense rate for the time during which the machine was operated on it.

The expense of maintaining the machine in idleness during the time it was not operated cannot legitimately be charged to the work done while it was operated, and should be put into another account.

We thus see that in every plant there are to be considered two kinds of burden:

a That which produces goods and which can legitimately be charged to the cost of those goods, and
b That which produces nothing, and must be put into some other account.

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In the past it has been too much the fashion to put these two kinds into one account and make the product bear both. This has led to so much confusion, and is so evidently wrong, that it is not worth discussion.

On the other hand, a careful consideration of the expense incurred while the plant is idle leads to very fruitful results: first, through an attempt to find out why the plant is idle, and then through an attempt to eliminate the causes of idleness, which are lack of work, lack of help, lack of material, repairs, etc.

Without going into the details of those subjects, it may be readily appreciated what advantages will be derived from a careful study of each of these causes.

This general view of the cost question leads to a further simplification of the problem which is worthy of careful consideration.

First, the expense of owning and maintaining a certain machine in idleness properly equipped for efficient operation should be substantially the same in any part of the country where the machine could be bought at substantially the same price.

Second, the amount of power, oil, waste, and repairs, and even supervision, of a certain machine should be substantially the same in any part of the country, if it were engaged upon substantially the same kind of work.

Following these lines of thought, we readily see that a standardization of cost methods and of costs is possible, which was unsuspected a few years ago.

While the writer and those with whom he has been associated have done quite a good deal of work on these lines, and while the results have been satisfactory to a degree that was entirely unanticipated, he does not yet feel that the matter has been developed to such a degree as to warrant detailed publication. The fact, however, that the Federal Government has placed so many contracts on a "cost plus" basis, leads him to set forth these ideas, which are the only ones which seem to him to give promise of avoiding an almost intolerable situation resulting from a complication of interests which is bound to arise in the near future.

It seems to the writer that much of the confusion on the subject of costs in the past has been due to a misconception of the subject. The intimate relation between production and costs has not been sufficiently recognized, for the accountant has looked upon costs as a bookkeeping proposition, whereas, in truth, costs are much more closely connected with engineering and production than with the subjects of bookkeeping and accounting.

If the engineer will recognize this fact and insist that money spent without any corresponding production must be kept separate from that which was productive, either directly or indirectly, many of the apparent contradictions with which we are so frequently faced will be eliminated.

As soon as we establish these methods, the following question is immediately put to us by the accountant and financier, "What are we going to do with this expense of idleness?" they having never before realized that it cost something to be idle.

My frank answer to that is that I do not know. Moreover, I don't care, provided they do not charge it to me in the prod-

ucts which I buy from them. My recommendation, however, would be that they see how they can eliminate such expense by proper managerial methods.

I am perfectly aware that it is extremely difficult to eliminate all of such expense, but I am also aware of the fact that it is extremely easy to eliminate a large proportion of it. The solution of this problem is one of the economic questions which the war will shortly force to our attention, and I insist that it is primarily a question to be solved by engineers rather than by financiers.

APPARATUS FOR COOLING, DRYING AND PURIFYING AIR

By W. J. BALDWIN, NEW YORK, N. Y.

Member of the Society

This paper describes an apparatus for purifying air and regulating its temperature and humidity by mechanical means. In principle it consists of the use of a cold spray for the purification process, after which the excess moisture, together with particles of dust, excess CO_2, etc., are separated from the air by centrifugal action. In one of its original forms the device was applied to the porthole of a ship for the purpose of drawing into the cabin large quantities of air out excluding rain or spray. It has also been used to remove CO_2 from vitiated air, as in the compartments of a submarine, and for removing particles of dust from the gases of combustion in a chimney.

THE necessity for removing dust and other impurities from the air needs no amplification from me, as we all recognize the advantages of pure air and nearly all strive in every way to obtain it.

The ordinary meaning of the term pure air, however, should be amplified, and when it appears in a contract it should mean more than that the air should not be fouled by the human breath and by exhalations from the human body. The engineer must not be content when making an examination within an enclosed structure simply to report that the air is maintained at some common standard of purity of contamination, expressed by the number of times the CO_2 within the room is in excess of the standard, good or bad, found to exist outside the enclosure. Such a standard gives only an approximate idea of the condition of the air within the enclosed space, and it is the roughest approximation under the common acceptance of the term.

Presumably there is no pure air near the surface of the ground, nor in the atmosphere of cities. The best we have exists at the tops of mountains, or on the ocean, but even this we are unable to standardize.

Air with about two parts of CO_2 in 10,000 is considered good, no matter where we find it; but in cities where much coal is burned the proportion is higher, and may rise to as high as 10 parts of CO_2 in 10,000. An increase from 2 to 4 parts in 10,000 for enclosed spaces above the outside conditions has been considered good, even for schools and hospitals, and very good for workshops.

These conditions, however, do not comprise the whole problem. Further effort should be directed toward drying air by some simple mechanical process. In attempting to free air from an excess of humidity, which is often as much of an impurity as are the other forms of contamination, I have the following data to offer:

About two years ago I worked to perfect an apparatus[1] that could be put in the porthole or the dead light of a ship and would exclude the rain or spray, while freely admitting large quantities of air to the cabin of the ship, without admitting the water. This led to freeing the air of an excess of humidity.

The experiments conducted with the preliminary apparatus for excluding rain or spray while freely admitting the air as in the case of a ship rolling heavily at sea, suggested the possibility of removing the excess of humidity in the air, particularly with a view to admitting air to the radio room of a ship, and not only exclude the rain and the spray but also regulating the humidity, so as to keep the air at *some common standard of saturation* as far as humidity was concerned. The purpose was to overcome a difficulty with the attuning apparatus of the receiving and sending instruments, either at sea or in the higher atmosphere.

This led to the design of an apparatus for a radio room on the lines already set forth, that would admit air not only separated from rain, salt spray and spume, but that would also condition or regulate the humidity within the room by keeping it at a common standard of humidity, regardless of the outside changes.

Cold water in the spray form will do this provided the spray can be gotten rid of after it has combined with the excess of humidity (steam in the air) and then separated from the air by some practicable form of apparatus that is simple, and that occupies small space.

While a shower of rain will clear the atmosphere, the elements of nature have all outdoors in which to set up the apparatus for such a result. The cabin of a ship or a radio cabinet is infinitely small in comparison with all outdoors, yet a similar result can be achieved in a space as small as a cabin or radio cabinet.

To accomplish this I used a cold-water spray apparatus similar to one I had designed two years earlier for the purpose of precipitating the CO_2 when found in great excess in a confined space, as in the hold of a submarine, when forced to stay a long time under water.

In this machine a spray of potash water was used in connection with a mechanical dust precipitator for the purpose of seizing on the carbonic acid in the air and throwing it down so as to eliminate the CO_2 at the dust and water discharge of the apparatus.

It was proposed to put the apparatus in a bulkhead; the discharge side of the apparatus coming into the air of the

[1] An account of this apparatus, with illustrations, appeared in the Proceedings of the American Society of Heating and Ventilating Engineers, January 1917.

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living quarters, the air freed of its CO_2 being forced backward again into the chamber of greatest vitiation, thus forming a cycle.

In the general experiments it was found that a prepared spray of chemical liquid or even cold water not only seized on the dust but on other gases in the air, with which the chemical in the spray would combine, and that a pure-water spray turned into the apparatus would keep the humidity of the air constant by suitable regulation of the temperature of the water spray. In a room at 90 deg. fahr. and a humidity of almost 90 per cent we could drop the humidity to 45 per cent by reducing the temperature of the spray to 70 deg. fahr.

A simple form of the apparatus arranged for cooling a room is shown in Fig. 1. The apparatus from the inlet to the

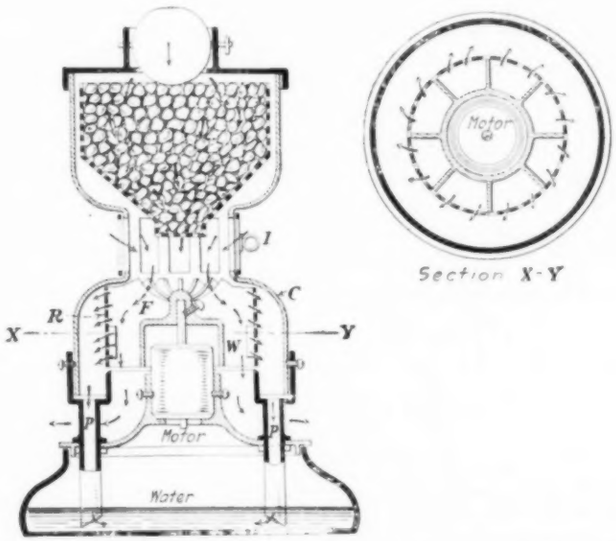

FIG. 1 APPARATUS FOR PURIFYING AND COOLING THE AIR OF A ROOM AND ILLUSTRATING ALSO THE PRINCIPLE USED IN VARIOUS OTHER FORMS OF THE DEVICE

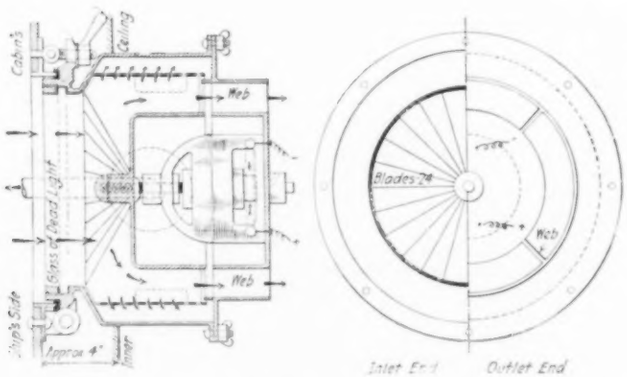

FIG. 2 APPARATUS ATTACHED TO PORTHOLE OF SHIP FOR ADMITTING AIR AND EXCLUDING RAIN OR SPRAY

line X-Y is an ordinary fan or blower F, and the downward extensions of the fan blades or wings W are necessary to accelerate the rotary motion of the air.

The rotor R is a rotating hoop of permeable metal, against the inner side of which the air is thrown with all its impurities. If the heavy particles in the air, such as dust, mud or particles of water, strike into the perforations of the hoop, they pass through into a quiet space formed by the outer case C. Or, if they strike on the solid part of the hoop, they are rubbed through the nearest holes by the forward movement of the air. They then pass into the quiet space C, drop down within it, and escape by the pipe or pipes P into the tank.

The air does not escape with the heavy particles, as might appear at first, for the lower ends of the pipe legs are sealed by the water in the tank. The tank may be of any shape, or there may be no tank, the separated particles going to a waste pipe.

The greater the velocity of the rotor R the more efficient is the apparatus. A speed of 5000 ft. per min. is very practicable, but 10,000 is not excessive, either from the point of bursting or for any other reason.

The fan gives the same static pressure as any other centrifugal blower of equal diameter and speed and requires only equal power for equal work, and the power required for separation and friction is considerably under 25 per cent of the blower power required to move the air.

The device as described above illustrates the principle of the various types of apparatus, whether used for taking the

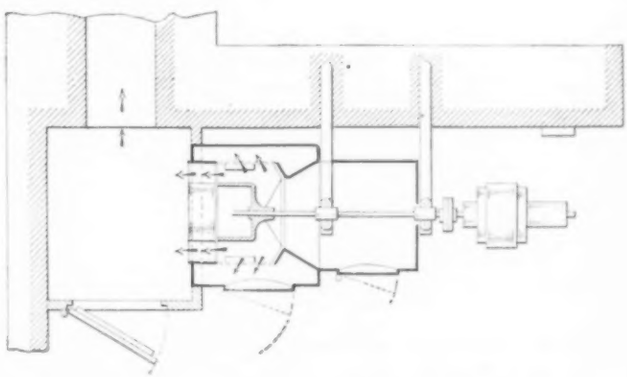

FIG. 3 APPLICATION OF APPARATUS TO BASE OF CHIMNEY FOR REMOVING PARTICLES OF DUST FROM GASES OF COMBUSTION

dust from the air, the CO_2 from a chimney or an enclosed space, the excess of humidity from the air, throwing down fog, cooling and moving air, etc. It will be noted that the ice in the upper tank serves both as a cooling medium and for the supply of cold water, broken into spray by the rapid motion of the fan, for the purification of the air.

In Fig. 2 is shown a type of the apparatus as developed for use in the porthole of a ship, and in Fig. 3 a horizontal design for the removal of dust particles from the gases of combustion in a chimney.

France and England freely acknowledge that they greatly decreased their efficiency by sending their scientific men to the trenches. Although they have since withdrawn most of those still alive and are now using them in special service, the dearth of technically trained men has been and is severely felt.

The American Association for the Advancement of Science and many national scientific societies affiliated with it will hold its seventieth meeting in Pittsburgh, Penn., from December 28, 1917, to January 2, 1918, under the auspices of the University of Pittsburgh, the Carnegie Institute, the Carnegie Technical Schools and other institutions.

REVISION OF BOILER CODE

THE Council of the Society directed that a hearing be conducted in accordance with the recommendation in the Boiler Code that a meeting at which all interested parties may be heard be held at least once in two years to make such revisions as may be found desirable in the Code and to modify the Code as the state of the art advances. The first of these meetings was held at the Society's headquarters in New York, December 8 and 9, 1916.

The Council also directed that the proposed revisions in the Boiler Code be published in THE JOURNAL with the request that they be fully and freely discussed, so as to make it possible for any one to suggest changes before the Rules are brought to the final form and presented to the Council for approval. Discussions should be mailed to Mr. C. W. Obert, Secretary of the Boiler Code Committee, 29 West 39th Street, New York, N. Y., and they will be presented and acted on by the Boiler Code Committee.

Revisions formulated by the Committee earlier in the year were published in the June 1917 issue of THE JOURNAL, pages 517 to 522, and in the August 1917 issue, page 705. The revisions which follow are divided into two parts, namely: Part I, Modifications of the Proposed Revisions published in the June and August issues (the modifications being made to conform with recommendations submitted to the Committee by those discussing the proposed revisions), and Part II, Aditional Revisions proposed by the Boiler Code Committee.

PART I

Modifications of the Proposed Revisions Published in the June and August Issues of THE JOURNAL

PAGE 50

PAR. 200. CHANGE PAR. 200 TO MAKE IT READ AS FOLLOWS:

200 *Staybolts.* The ends of screwed staybolts shall be riveted over or upset by equivalent process. Staybolts must be hollow or the outside ends of solid staybolts, 8 in. and less in length, shall be drilled with a hole at least 3-16 in. diameter to a depth extending at least ½ in. beyond the inside of the plates, except on boilers having a grate area not exceeding 15 sq. ft., or the equivalent in gas or oil fired boilers, where the drilling of staybolts is optional. Solid staybolts over 8 in. long, and flexible staybolts of either the jointed or ball and socket type need not be drilled.

PAR. 201. ADD TO PAR. 201 THE FOLLOWING:

If the outstanding legs of the two members are fastened together so that they act as one member in resisting the bending action produced by the load on the rivets attaching the members to the head of the boiler, and provided that the spacing of these rivets attaching the members to the head is approximately uniform, the members may be computed as a single beam uniformly loaded and supported at the points where the through braces are attached.

PAR. 214. CHANGE PAR. 214 TO MAKE IT READ AS FOLLOWS:

214 *Areas of Segments of Heads to be stayed.* The area of a segment of a head to be stayed shall be the area enclosed by lines drawn 2 in. from the tubes and a distance d from the shell as shown in Figs. 13 and 14. The value of d used shall be the larger of the following values but not less than 3 in.

(1) d = the outer radius of the flange, not exceeding 8 times the thickness of the head

(2) $d = \frac{5 \times t}{\sqrt{P}}$

Where d = unstayed distance from shell in inches
t = thickness of head in sixteenths of an inch
P = maximum allowable working pressure in lb. per sq. in.

PAR. 215. CHANGE PAR. 215 TO MAKE IT READ AS FOLLOWS:

215 When the heads of drums of water tube boilers are 30 in. or less in diameter and the tube plate is stiffened by flanged ribs or gussets, no stays need be used if a hydrostatic test to destruction of a boiler or unit section built in accordance with the construction, shows that the factor of safety is at least five.

PAGE 54

TABLE 4. SEVERAL REVISIONS HAVE BEEN MADE IN TABLE 4 AND IT WILL NOW READ AS FOLLOWS:

TABLE 4 MAXIMUM ALLOWABLE STRESSES FOR STAYS AND STAYBOLTS

	Description of Stays	Stresses, lb. per sq. in.	
		For lengths between supports not exceeding 120 diameters	For lengths between supports exceeding 120 diameters
a	Unwelded or flexible stays less than twenty diameters long screwed through plates with ends riveted over	7,500	.....
b	Unwelded stays and unwelded portions of welded stays, except as specified in line *a* and line *c*	9,500	8,500
c	Steel through stays exceeding 1½ in. diameter	10,400	9,000
d	Welded portions of stays	6,000	6,000

PAGE 58

PAR. 231. CHANGE PAR. 231 TO MAKE IT READ AS FOLLOWS:

231 *Maximum Allowable Working Pressure on Truncated Cones. a.* Upper combustion chambers of vertical submerged tubular boilers made in the shape of a frustum of a cone, when not over 38 in. diameter at the large end, may be used without stays if computed by the rule for plain cylindrical furnaces (Par. 239) making D in the formula equal to the diameter at the large end, and provided that the longitudinal joint conforms to the requirements of Par. 239.

b. When over 38 in. in diameter at the large end, that portion which is over 30 in. in diameter shall be fully supported by staybolts or gussets to conform to the provisions for staying flat surfaces. In this case the top row of staybolts shall be at a point where the cone top is 30 in. or less in diameter.

In calculating the pressure permissible on the unstayed portion of the cone, the vertical distance between the horizontal planes passing through the centers of the rivets at the cone top, and through the center of the top row of staybolts shall be used as L in Par. 239, and D in that paragraph shall be the inside diameter at the center of the top row of staybolts.

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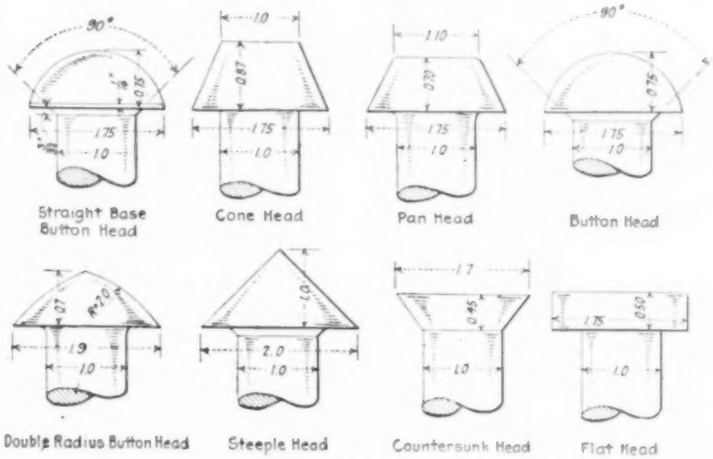
PAR. 239. INSERT AFTER THE FORMULA AND JUST PRECEDING THE EXAMPLE IN PAR. 239, ELIMINATING THE PRESENT SENTENCE:

Where the furnace has a riveted longitudinal joint, it may be of the lap type for inside diameters not exceeding 36 in. for furnaces 36 in. or less in height or length, and for inside diameters not exceeding 30 in., irrespective of the height or length. Otherwise butt and strap construction shall be used. The efficiency of the joint shall be greater than:

$$\frac{P \times D}{1250 \times t}$$

PAGE 64

PAR. 246. AS STATED IN THE JUNE ISSUE OF THE JOURNAL IT HAD BEEN DECIDED TO CHANGE PAR. 246, TO PAR. 246*a*, AND TO ADD PAR. 247, CALLING IT PAR. 246*b*. SINCE THE PUBLICATION OF THE JUNE ISSUE OF THE JOURNAL IT HAS BEEN PROPOSED TO REVISE THIS NEW PAR. 246*b* (FORMERLY PAR. 247) TO READ AS FOLLOWS:



Proportions may be larger or 1/10 smaller than those shown.
Fillet under heads may be used but are not required.

FIG. 17A ACCEPTABLE FORMS OF RIVET HEADS

b A cast-iron header when tested to destruction, shall withstand a hydrostatic pressure of at least 1200 lb. per sq. in. and a malleable-iron header, 1500 lb. A hydrostatic test at 400 lb. per sq. in. for cast iron and 500 lb. per sq. in. for malleable iron shall be made on all new headers with tubes attached.

This has been referred to a Sub-Committee of the Boiler Code Committee on Malleable Iron for consideration.

PAR. 247. AS IT WAS DECIDED TO CHANGE PAR. 247 TO PAR. 246*b*, A NEW PAR. 247 WAS PROPOSED AND PUBLISHED IN THE JUNE ISSUE OF THE JOURNAL. THE NEW PARAGRAPH CONTAINED TWO PARTS, *a* AND *b*. IT HAS BEEN DECIDED TO OMIT THE FIRST PART, *a*, ENTIRELY, AND TO REVISE THE REMAINING PORTION SLIGHTLY, SO THAT PAR. 247 WILL READ AS FOLLOWS:

247 Where it is impossible to calculate with a reasonable degree of safety the strength of a boiler structure or any part thereof, a full sized sample shall be built by the manufacturer and tested to destruction in the presence of the Boiler Code Committee or one or more representatives of the Boiler Code Committee appointed to witness such test.

PAGE 65

PAR. 253. CHANGE PAR. 253 TO MAKE IT READ AS FOLLOWS:

253 *Drilling of Holes.* All rivet holes and staybolt holes and holes in braces and lugs shall be drilled full size or they may be punched not to exceed ¼ in. less then full diameter for material over 5-16 in. in thickness, and ⅛ in. less than full diameter for material not exceeding 5-16 in. in thickness, and then drilled or reamed to full diameter with plates, butt straps, braces, heads and lugs bolted in position. Tack bolts for seams shall be not over 12 in. apart.

PAR. 255. THE ILLUSTRATION SHOWING FORMS OF RIVET HEADS THAT WILL BE ACCEPTABLE IS FIG. 17*a*.

PAGE 68

PAR. 268. CHANGE PAR. 268 TO MAKE IT READ AS FOLLOWS:

268 *Threaded Openings.* A threaded pipe connection 1 in. in diameter or over shall have not less than the number of threads given in Table 7.

TABLE

If the thickness of the material in the boiler is not sufficient to give such number of threads, the opening shall be reinforced by a pressed steel, cast steel, or bronze composition flange, or plate, so as to provide the required number of threads as shown in Fig. 18a.

When the maximum allowable working pressure exceeds 100 lb. per sq. in., a flanged nozzle shall be used for all threaded pipe openings over 3 in. pipe size.

PAR. 269. CHANGE PAR. 269 TO MAKE IT READ AS FOLLOWS:

269 *Safety Valve Requirements.* Each boiler shall have two or more safety valves, except a boiler for which one safety valve having a relieving area of ¾ sq. in. or less is required by the rules.

PAGE 69

PAR. 273. CHANGE PAR. 273 TO MAKE IT READ AS FOLLOWS:

273 Each safety valve shall be plainly marked by the manufacturer. The markings may be stamped on the body, cast on the body, or stamped, etched, or cast on a plate or plates riveted to the body, and shall contain the following:

a The name or identifying trademark of the manufacturer
b The nominal diameter with the words "Bevel Seat" or "Flat Seat"
c The steam pressure at which it is set to blow
d The lift in inches of the valve disc from its seat, measured at a pressure 3 per cent higher than that at which the valve is set to blow
e The weight of steam discharged in pounds per hour at a pressure 3 per cent higher than that for which the valve is set to blow
f A.S.M.E. Standard.

PAGE 74

PAR. 282. CHANGE PAR. 282 TO MAKE IT READ AS FOLLOWS:

282 For the purposes of inspection and to insure the valve being free, each safety valve shall have a substantial lifting device by which the valve may be raised from its seat at least 1-16 in. when there is no pressure on the boiler.

PAR. 283. ADD TO PAR. 283 THE FOLLOWING:

The seats and discs of safety valves shall be non-ferrous material. The seat of a safety valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.

PAR. 284. ADD TO PAR. 284 THE FOLLOWING:

284 Springs used in safety valves shall not show a permanent set exceeding 1-32 in. ten minutes after being released from a cold compression test closing the spring solid. The spring shall be so constructed that the valve can lift from its seat 1-10 the diameter of the seat before the coils are closed or before there is other interference.

PAR. 286. CHANGE PAR. 286 TO MAKE IT READ AS FOLLOWS:

286 All flange dimensions shall conform to the American Standard given in Tables 15 and 16 of the Appendix for the pressures therein specified except that the face of the safety valve flange and the nozzle to which it is attached may be flat and without the raised face for pressures up to and including 250 lb. per sq. in. For higher pressures, the raised face shall be used.

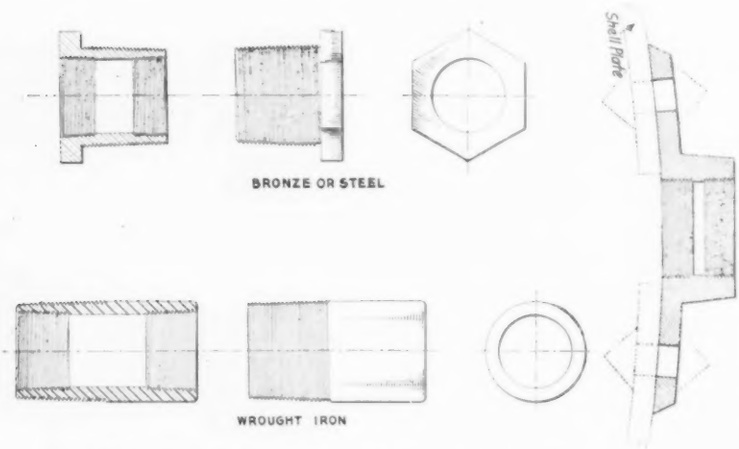


FIG. 18A TYPES OF BOILER FLANGES AND BUSHINGS

PAGE 75

PAR. 291. ADD TO PAR. 291 THE FOLLOWING:

The lowest permissible water level for various classes of boilers shall be the location of the fusible plug as given in Par. 430 of the Appendix.

PAR. 292. A REVISION OF THIS PARAGRAPH WAS PUBLISHED IN THE JUNE ISSUE OF THE JOURNAL BUT IT HAS BEEN FINALLY DECIDED TO CANCEL THIS PROPOSED REVISION AND TO LEAVE PAR. 292 AS IT STANDS IN THE 1914 EDITION OF THE CODE. THIS MATTER HAS BEEN REFERRED TO A SPECIAL SUB-COMMITTEE OF THE BOILER CODE COMMITTEE.

PAGE 76

PAR. 299. CHANGE PAR. 299 TO MAKE IT READ AS FOLLOWS:

299 *Nozzles and Fittings.* Flanged cast iron pipe fittings used for boiler parts, for pressures up to and including 160 lb. per sq. in., shall conform to the American Standard given in Tables 15 and 16 of the Appendix, except that the face of the flange of a safety valve as well as that of a safety valve nozzle, may be flat and without the raised face. For pressures above 160 lb. per sq. in., steel cast or wrought steel fittings shall be used for boiler parts with exceptions specified in Pars. 9 and 12. An allowable variation of 20 per cent from the flange thickness required by Tables 15 and 16 may be made for steel cast and forged steel fittings, leaving the drilling of bolt holes unchanged. For pressures above 250 lb. per sq. in., the flange thickness and the thickness of the bodies shall be increased to keep within the same deflection limits and to give at least the same factor of safety as the fittings specified in Tables 15 and 16. The flange of a safety valve may have a flat face for pressures up to and including 250 lb. per sq. in., and shall have a raised face at higher pressures; a safety valve nozzle may have a flat face for pressures up to and including 250 lb. per sq. in. and shall have a raised face at higher pressures. Tables 15 and 16 do not apply to flanges on the boiler side of steam nozzles or to flanges left by the manufacturer as part of the boiler, and do not apply to fittings designed as part of the boiler.

PAR. 307. CHANGE PAR. 307 TO MAKE IT READ AS FOLLOWS:

307 *Blow-off Piping.* A surface blow-off shall not exceed 1½ in. pipe size and the internal and external pipes shall form a continuous passage, but with clearance between their ends and arranged so that the removal of either will not disturb the other. A properly designed brass or steel bushing as shown in Fig. 18A or flanged connection, shall be used.

PAGE 77

PAR. 311. CHANGE PAR. 311 TO MAKE IT READ AS FOLLOWS:

311 *a.* On all boilers except those used for traction and portable purposes, when the maximum allowable working pressure exceeds 125 lb. per sq. in., each bottom blow-off pipe shall have two valves, or a valve and a cock, and such valves, or valve and cock, shall be extra heavy, except that on a boiler having multiple blow-off pipes, a single master valve may be placed on the common blow-off pipe from the boiler, in which case only one valve on each individual blow-off is required.

b. All traction and portable boilers shall have one bottom blow-off valve; when the maximum allowable working pressure exceeds 125 lb. per sq. in., the blow-off valve shall be extra heavy.

PAR. 315. ALLOW THE REVISION TO STAND AS IT APPEARS IN THE JUNE JOURNAL AND ADD TO IT THE FOLLOWING:

In Fig. 18*a* is illustrated a standard form of flange to use on boiler shells for passing through piping such as feed, surface, blow-off connections, etc., and which permits of the pipes being screwed in solid from both sides in addition to the reinforcing of the opening in the shells.

PAGE 79

PAR. 325. ALLOW THE REVISION TO STAND AS IT APPEARS IN THE JUNE JOURNAL AND ADD TO IT THE FOLLOWING:

For traction or portable boilers, studs with pipe threads may be used.

PAR. 328. CHANGE PAR. 328 TO MAKE IT READ AS FOLLOWS:

328 A water-tube boiler shall have the firing door or clinker doors of the inward opening type unless such doors are provided with substantial and effective latching or fastening devices to prevent them from being blown open by pressure on the furnace side.

PAGE 82

PAR. 343. ALLOW THE REVISION TO STAND AS IT APPEARS IN

THE JUNE ISSUE EXCEPT THAT IT IS NOW MADE ONE PARAGRAPH AS FOLLOWS:

343 In a *hot-water* boiler to be used exclusively for heating buildings or hot-water supply, when the diameter does not exceed 60 in. and the grate area does not exceed 10 sq. ft., or equivalent as defined in Pars. 359 and 360, longitudinal lap joints will be allowed. When the grate area exceeds 10 sq. ft., or equivalent as defined in Pars. 359 and 360, and the diameter of the boiler does not exceed 60 in., longitudinal lap joints will be allowed provided the maximum allowable working pressure does not exceed 50 lb. per sq. in.

PAGE 113—APPENDIX

PAR. 430. A REVISION OF THE FIRST LINE OF PAR. 430 WAS PUBLISHED IN THE JUNE ISSUE OF THE JOURNAL. IT HAS NOW BEEN DECIDED TO CANCEL THIS REVISION AND LET THE FIRST LINE STAND AS IT APPEARS IN THE 1914 EDITION OF THE CODE. IN THE JUNE JOURNAL A PROPOSED ADDITION TO PAR. 430 WAS PUBLISHED, AND IT HAS BEEN DECIDED TO ALLOW THIS ADDITION TO REMAIN AS IT APPEARS IN THE JOURNAL, SO THAT THE FINAL FORM OF PAR. 430 IS THE SAME AS IN THE 1914 EDITION OF THE CODE WITH THE ADDITION OF CLAUSE *r* AS FOLLOWS:

r Fire Engine Boilers are not usually supplied with fusible plugs. Unless special provision is made to keep the water above the firebox crown sheet other than by the natural water level, the lowest permissible water level shall be at least 3 in. above the top of the firebox crown sheet.

PART II

Additional Revisions Proposed by the Boiler Code Committee

PAGE 1

TITLE PAGE

Change line at bottom of p. 1 which reads as follows:

Edition of 1914 with Index

to read as follows:

Edition of 1918

(New edition of Boiler Code to be copyrighted under date of 1918).

PAGE 2

LETTER TO THE COUNCIL

Change letter to the Council to read as follows:

To the Council of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

GENTLEMEN: Your Committee respectfully submits the following revised report on Rules for the construction of, and allowable working pressures on stationary boilers, this report forming a part of the task that has been assigned to it. Stationary boilers as here considered are land boilers and include portable and traction boilers. The Rules do not apply to boilers which are subject to federal inspection and control, such as marine boilers, boilers of steam locomotives and other self-propelled railroad apparatus.

The primary object of the Rules is to secure safe boilers. The interests of boiler users and manufacturers have been carefully considered and the requirements made such that they will not entail undue hardship by departing too widely from present practice.

The Code applies only in part to certain special forms of boilers such as those of the forced circulation or flash type. New matter has been added to state that the material for boilers of this class shall conform to the requirements of the Code, and that other requirements shall also be met except where they relate to special features of construction made necessary in boilers of this type, and to accessories that are manifestly not needed or used in connection with such boilers, such as water gages, water columns, and gage cocks.

In those states and municipalities which have adopted the Boiler Code, your Committee recommends that all requests for interpretations of the Boiler Code be referred to the state authorities having jurisdiction over such matters. In order to maintain uniformity of practice it is also suggested that the authorities having jurisdiction be requested to submit all inquiries where there is any question of doubt to the Boiler Code Committee. Where there is a question respecting the interpretation of the Code, or where constructions apparently are not covered by the Code, it will be most desirable to have the matter referred to the Boiler Code Committee. Unless this procedure is followed, the aim to obtain uniformity in the application of the Code will be defeated. The Boiler Code Committee desires to coöperate to the limit of its ability in assisting in the application of the Code, and will take pleasure in considering all matters where there is any question of doubt that may be brought before it by the various states and municipalities that adopt the Code.

The Committee does not pass on questions concerning specific designs of boilers or appurtenances thereto.

Your Committee recommends that a hearing be held by the Boiler Code Committee at least once in four years at which all interested parties may be heard, in order that such revisions may be made as are found to be desirable, as the state of the art advances.

Yours truly,

JOHN A. STEVENS, *Chairman*.

Wm. H. Boehm, Boiler Insurance
Rolla C. Carpenter, Engineering Research
Frank H. Clark, Railroad Sub-Committee, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Francis W. Dean, Consulting Engineers
Thomas E. Durban, Chairman, The American Uniform Boiler Law Society. All types of boilers
Elbert C. Fisher, Scotch marine and other types of boilers
Charles E. Gorton, Steel heating boilers
Arthur M. Greene, Jr., Engineering Education
Richard Hammond, Scotch marine and other types of boilers
A. L. Humphrey, Railroad Sub-Committee, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Charles L. Huston, Boiler plate manufacturer
D. S. Jacobus, Water-tube boilers
S. F. Jeter, Boiler Insurance
Wm. F. Kiesel, Jr., Railroad Sub-Committee, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
W. F. MacGregor, National Association of Tractor and Thresher Manufacturers
Edward F. Miller, Engineering Research
M. F. Moore, Steel heating boilers
I. E. Moultrop, Boiler users
Richard D. Reed, Cast iron heating boilers
H. H. Vaughan, Railroad Sub-Committee, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
C. W. Obert, Secretary to Committee.

PAGE 5

HEADING

Insert above heading of p. 5 the following:

A.S.M.E. Boiler Code

PAGE 7

HEADING

Insert above heading of p. 7 the following:

A.S.M.E. Boiler Code

PAGE 8

PAR. 9. IT HAS BEEN PROPOSED TO ADD A SENTENCE TO PAR. 9, AS FOLLOWS:

Malleable iron may be used when the maximum allowable working pressure does not exceed 200 lb. per sq. in., and the maximum inside diameter or diagonal dimension does not exceed 7 in.

This has been referred to a Sub-Committee of the Boiler Code Committee on Malleable Iron for consideration.

PAR. 14. INSERT THE FOLLOWING AT THE BEGINNING OF PAR. 14:

In determining the maximum allowable working pressure,

PAGE 10

PAR. 21. ADD TO PAR. 21 THE FOLLOWING:

Specifications and maximum allowable working pressures for various gages for super-heater tubes shall be the same as for water tubes.

PAGE 12

PAR. 29*b*. STRIKE OUT THE WORDS "OR UNDER" FROM THE FIRST LINE

PAGE 44

PAR. 182. MODIFICATION OF THIS PARAGRAPH IS IN THE HANDS OF A SPECIAL SUB-COMMITTEE OF THE BOILER CODE COMMITTEE OF BACK PITCH

PAGE 46

PAR. 192. ADD NEW SECTION TO PAR. 192 AS FOLLOWS:

c The strength of those ligaments between the tube holes which are subjected to a longitudinal stress shall be at least one-half the required strength of those ligaments which come between the tube holes which are subjected to a circumferential stress.

PAGES 55-56

PAR. 221. REPLACE FIG. 15 BY REVISED CUT

PAGE 47

PAR. 193. MODIFICATION OF THIS PARAGRAPH IS IN THE HANDS OF A SPECIAL SUB-COMMITTEE OF THE BOILER CODE COMMITTEE ON DIAGONAL LIGAMENTS

PAGE 49

PAR. 198. CHANGE PAR. 198 TO READ AS FOLLOWS:

198 A manhole opening in a dished head shall be flanged to a depth of not less than three times the *required* thickness of the head measured from the outside.

PAR. 199. ADD THE FOLLOWING AT THE END OF PAR. 199:

Acceptable proportions for the ends of through stays are indicated in Fig. 12a.

PAGE 59

PAR. 234. UNDER "WHERE" CHANGE DERIVATION OF D TO READ:

D = least horizontal distance between tube centers on a horizontal row, in.

IMMEDIATELY BELOW THE DERIVATION OF LETTERS INSERT:

Where tubes are staggered the vertical distance between the center line of tubes in adjacent rows must be not less than $1/2 \sqrt{(2dD + 4^2)}$.

The above formula has been referred to a special Sub-Committee of the Boiler Code Committee.

PAGE 64

PAR. 245. IT HAS BEEN PROPOSED TO CHANGE PAR. 245 TO READ AS FOLLOWS:

245 *Cast-iron and Malleable Iron Headers.* The pressure allowed on a water-tube boiler shall not exceed 160 lb. per sq. in. when the tubes are secured to cast-iron headers, nor 200 lb. when the tubes are secured to malleable iron headers. The form and size of the internal cross section perpendicular to the longer axis of a cast-iron or malleable iron header at any point shall be such that it will fall within a 7 in. by 7 in. rectangle.

This has been referred to a Sub-Committee of the Boiler Code Committee on Malleable Iron for consideration.

PAR. 251. CHANGE PAR. 251 TO READ AS FOLLOWS:

251 The ends of all tubes, suspension tubes and nipples shall be flared not less than $\frac{1}{8}$ in. over the diameter of the tube hole on all water-tube boilers and superheaters, or they may be flared not less than $\frac{1}{8}$ in., rolled and beaded, or flared, rolled and welded.

PAGE 65

PAR. 254. CHANGE PAR. 254 TO READ AS FOLLOWS:

254 After drilling or reaming rivet holes the plates and butt straps shall be separated, the burrs and chips removed, the plates and butt straps reassembled metal to metal with barrel pins fitting the holes, and with tack bolts.

PAR. 256. CHANGE PAR. 256 TO READ AS FOLLOWS:

256 Rivets shall be machine driven wherever possible with sufficient pressure to fill the rivet holes, and shall be allowed to cool and shrink under pressure. Barrel pins fitting the holes and tack bolts shall be used. The tack bolts shall be not over 12 in. apart, and a rivet shall be driven each side of each tack bolt before removing the tack bolt.

PAGES 65-66

PARS. 260-261

The Executive Committee of the Boiler Code Committee will report later respecting openings that need not be reinforced and on methods of reinforcing openings that need not come under the same rules as for manholes.

PAGE 67

PAR. 261. CHANGE THE TWO LINES OF PAR. 261 AT THE TOP OF P. 67 TO READ:

l = length of center line of opening in shell in direction parallel to axis of shell plus the sum of the diameters of the rivet holes that come in or adjacent to the center line of the opening, in.

PAGE 69

PAR. 272. CHANGE PAR. 272 TO READ AS FOLLOWS:

272 Safety valves shall be of the direct spring loaded

pop type with seat and bearing surface of the disc inclined at any angle between 45 deg. and 90 deg. to the center line of the spindle. The valve shall be rated at a pressure 3 per cent in excess of that at which the valve is set to blow.

Safety valves may be used which are constructed with pilot valves or assistant cylinders. Such valves may give any opening up to the full discharge capacity of the area of the opening at the base of the valve, provided the opening of the valve is gradual so as not to induce lifting of the water in the boiler.

All safety valves shall be so constructed that shocks, detrimental to the valve or boiler, are not produced.

The question of the blow-down limit has been referred back to the Executive Committee.

PAR. 274. CHANGE PAR. 274 TO READ AS FOLLOWS:

274 The minimum allowable relieving capacity of the safety valve or valves required on a boiler shall be determined on the basis of 6 lb. of steam per hour per sq. ft. of boiler heating surface for water tube boilers. For all other types of power boilers with pressure above 100 lb. the minimum allowable relieving capacity shall be determined on the basis of 5 lb. of steam per hour per sq. ft. of boiler heating surface and on the basis of 3 lb. with pressures at or below 100 lb. per sq. in. The heating surface shall be computed for that side of the boiler surface exposed to the products of combustion, exclusive of the superheating surface. In computing the heating surface for this purpose only the tubes, fireboxes, shells, tube sheets and the projected area of headers need be considered. The minimum number of safety valves required shall be determined on the basis of the minimum allowable relieving capacity and the relieving capacity marked on the valves by the manufacturer.

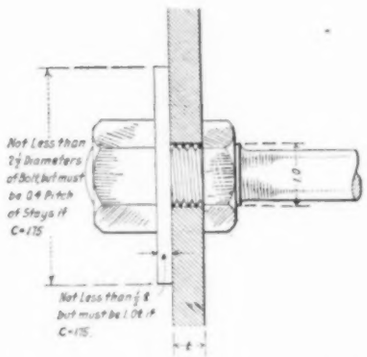


FIG. 12A ACCEPTABLE PROPORTIONS FOR ENDS OF THROUGH STAYS

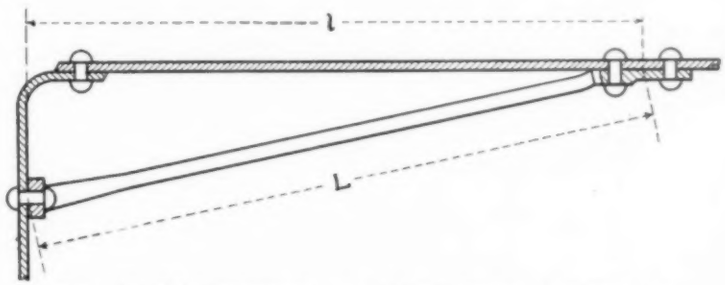


FIG. 15 MEASUREMENTS FOR DETERMINING STRESSES IN DIAGONAL STAYS

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PAR. 287. CHANGE PAR. 287 TO READ AS FOLLOWS:

287 When the valve body is marked with the letters A.S.M.E. Std. as required by Par. 273, this shall be a guarantee by the manufacturer that the valve conforms with the details of construction herein specified.

PAR. 288. CHANGE PAR. 288 TO READ AS FOLLOWS:

288 Every superheater shall have one or more safety valves near the outlet. The discharge capacity of the safety valve or valves on an attached superheater may be included in determining the number and size of safety valves for the boiler provided there are no intervening valves between the superheater safety valve and the boiler, and provided the discharge capacity of the safety valve or valves on the boiler as distinct from the superheater is at least 75 per cent. of the total valve capacity required.

PAGE 77

PAR. 314 OMIT THE LAST SENTENCE SO THAT PAR. 314 READS AS FOLLOWS:

314 *Feed Piping.* The feed pipe of a boiler shall have an open end or ends inside of the boiler.

PAR. 317 ADD TO PAR. 317 THE FOLLOWING:

Wherever globe valves are used on feed piping, the inlet shall be under the disc of the valve.

PAGE 79

PAR. 332. CHANGE PAR. 332 TO READ AS FOLLOWS:

332 After obtaining the stamp to be used when boilers are to be constructed to conform with the A.S.M.E. Boiler Code, it is understood that a state inspector, municipal inspector, or an inspector employed regularly by an insurance company which is authorized to do a boiler insurance business in the state in which the boiler is built and in the state in which it is to be used, is to be notified that an inspection is to be made and shall inspect such boilers during construction and after completion. At least two inspections shall be made, one before reaming rivet holes and one at the hydrostatic test. In stamping the boiler after completion, if built in compliance with the Code, the builder shall stamp the boiler in the presence of the inspector, after the hydrostatic test, with the A.S.M.E. Code stamp, the builder's name and the serial number of the manufacturer. A data sheet shall be filled out and signed by the manufacturer and the inspector. This data sheet together with the stamp on the boiler shall denote that it was constructed in accordance with the A.S.M.E. Boiler Code.

The name of the state in which the boiler is built shall be stamped under and about one-half inch below the symbol. The name or initials of the manufacturer shall be stamped below the name of the state, together with the serial number of the boiler, and not over one-half inch therefrom. (Samples of data sheets appear in the Appendix, p. ....)

Stamps for the official symbol shown in Fig. 19 are obtainable from The American Society of Mechanical Engineers.

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FIG. 20, PAR. 332.

A revision of Fig. 20 was published in the June issue of THE JOURNAL, but it has been decided to revise it again as follows:

(Name of State)
.....STD
(Manufacturer's number of boiler)
.....1
(Name and location of builder)
(Installation No.) (Name of State)
.....1
(Year put into service)
.....

PAGE 81

HEADING. MAKE HEADING OF P. 81 READ AS FOLLOWS:

A.S.M.E. Boiler Code

PART I—SECTION II

BOILERS USED EXCLUSIVELY FOR LOW PRESSURE STEAM AND HOT WATER HEATING AND BOILERS FOR HOT WATER SUPPLY[1]

PAR. 345. CHANGE PAR. 345 TO READ AS FOLLOWS:

345 A boiler used for low pressure steam heating or for hot water supply shall be provided with washout holes for the removal of any sediment that may accumulate therein. Steel shell boilers of the locomotive or vertical fire-tube type shall conform to the requirements of Pars. 265 and 266 for washout holes.

PAR. 354. CHANGE PAR. 354 TO READ AS FOLLOWS:

354*a*. No shut-off of any description shall be placed between the safety or water relief valves and boilers, nor on discharge pipes between them and the atmosphere.

b. No boiler for hot water supply shall be connected to a water supply pipe fitted with a check valve or pressure reducing valve.

PAGE 86

PAR. 363. ADD TO PAR. 363 THE FOLLOWING:

Temperature Regulator. A temperature regulator shall be applied to *hot water* supply boilers which will prevent the temperature from rising above 200 deg. fahr.

PAGE 89

HEADING. INSERT ABOVE HEADING OF P. 89 THE FOLLOWING:

A.S.M.E. Boiler Code

PAGE 91

PAR. 392. CHANGE PAR. 392 TO READ AS FOLLOWS:

392 In case either of the methods outlined in sections *b* or *c* of Par. 391 is employed, the safety valve capacities shall be those given in Table 10.

PAGE 95—APPENDIX

HEADING. INSERT ABOVE HEADING OF PAGE 95 THE FOLLOWING:

A.S.M.E. Boiler Code

PAGE 103

PAR. 417

CHANGE FIRST SENTENCE OF PAR. 417 TO READ AS FOLLOWS:

417 Figs. 28 and 29 illustrate other joints that may be used in which eccentric stresses are avoided.

ALSO IN APPENDIX INSERT THE FOLLOWING:

Where repairs are necessary which in any way affect the working pressure or safety of a boiler, a state inspector, municipal inspector, or an inspector employed regularly by an insurance company which is authorized to do a boiler insurance business in the state in which the boiler is used, shall be called for consultation and advice as to the best method of making such repairs; after such repairs are made they shall be subject to the approval of a state inspector, municipal inspector, or an inspector regularly employed by an insurance company which is authorized to do a boiler insurance business in the state in which the boiler is used.

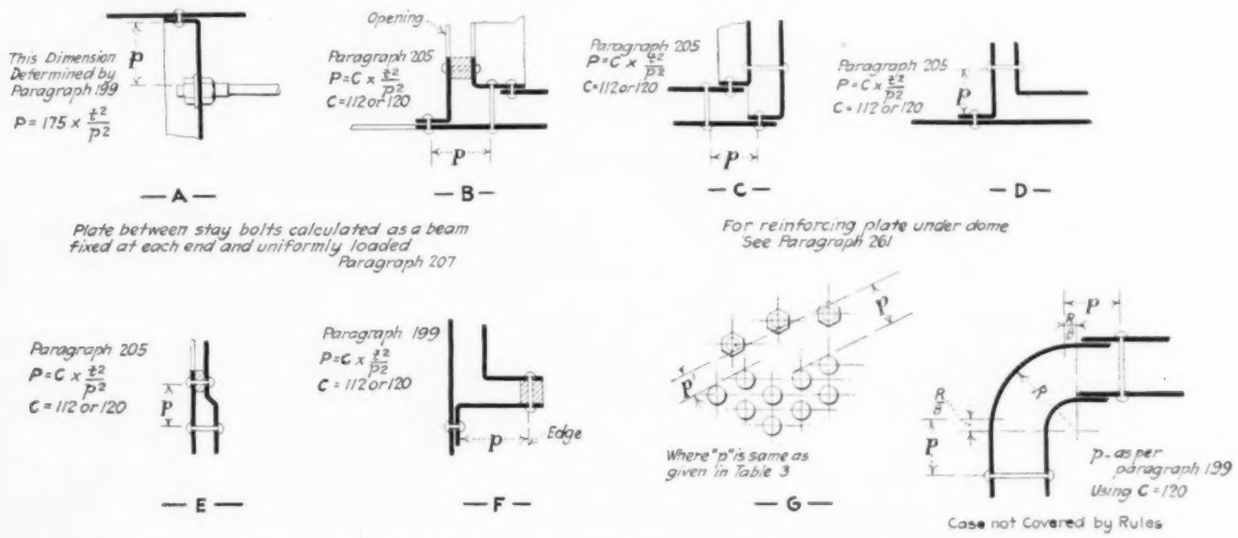

FIG. 31 DETAILS SHOWING APPLICATION OF PARS. 205, 206 AND 207 TO THE STAYING OF WET-BOTTOM BOILERS

Under Table 3 reference is made to Fig. 31 showing application of Pars. 205, 206 and 207.

JOINT MEETING OF THE SPECIAL SUB-COMMITTEE ON MATERIAL SPECIFICATIONS

A joint meeting of the special Sub-Committee of the Committee A-1 on Steel of the American Society for Testing Materials and the special Sub-Committee of The American Society of Mechanical Engineer's Boiler Code Committee, appointed to confer on the subject of material specifications, was held in the Engineering Societies Building, New York, on October 26, 1917.

Specifications for Boiler-Plate Steel

It was agreed that 8000-lb. range for tension tests of firebox steel is too small to allow for check tests and that in order to make check tests the range should be 10,000 lb. It

[1] Domestic kitchen range boilers and their water backs, furnace heating coils and their appurtenances and domestic coil or pipe, gas or oil heaters, are not included under this Section.

MANUFACTURERS' DATA REPORT OF BOILER
As Required by the Provisions of the A.S.M.E. Rules

1. Boiler manufactured by..... at.....
2. Boiler manufactured for..... of.....
3. Type of boiler **LOCOMOTIVE** and other Internally-Fired Boilers, **STATIONARY**.....
   BOTTOM Serial No.....
   (State if wet bottom or open bottom.)
   (Alternate) **HORIZONTAL RETURN TUBULAR** and other Externally-Fired and Water Tube Boilers.
4. Shell plates and butt straps made by.....
5. (*a.*) Mill test report on shell plates:.....Yield point.....
   (Tensile strength. Lb. per sq. in.) (Lb. per sq. in.)
   (*b.*) Elongation.....%. Phos....0.....%. **Sul**....0.....%. **Man**....0....to 0.....%
   (In 8 inches.)
6. Mill test report on butt straps..... Thickness.....in.
   (Brand and tensile strength.)
7. Stamps on shell plates..... Thickness.....in.
   (Brand and tensile strength.)
8. Furnace sheets made by.....Stamped..... Thickness.....in.
   (Brand and tensile strength.)
9. Heads made by.....Stamped..... Thickness.....in.
   (Brand and tensile strength.)
10. Rivets made by..... Material.....
11. Stays made by..... Material.....
12. Channel or angle irons on heads.....Upper tubes to shell.....in.
    (No. and size on each head.)
13. (*a.*) Stays above tubes.....
    [No. each head, and type (through, head to head, or diagonal, welded or weldless) and net cross-sectional area of each size of each type.]
    (*b.*) .....Area to be stayed.....sq. in.
    (Each head above tubes.)
    (*c.*) Stays below tubes.....
    [No. each head, and type (through, head to head, or diagonal, welded or weldless) and net cross-sectional area of each size of each type.]
    (*d.*) .....Area to be stayed.....sq. in.
    (Each head below tubes.)
14. (*a.*) Stay bolts:—Made by.....Material.....**Size**.....sq. in.
    (Area at bottom of thread.)
    (*b.*) Maximum pitch of.....in.×.....in.
    [Circumferential (or Horizontal) X Vertical.]
15. **Shell:—Diam.**.....in. Length over all.....ft.....in. No. of courses.....
    (Inside of outside course.)
16. (*a.*) Longitudinal joints:—**Type of**..... Riveting.....
    (Double, triple, quad., etc.)
    Diam. rivet holes.....in. Pitch of rivets....."×....."×....." **Efficiency of joint**.....%
    (Minimum pitch on each row.)
    (*b.*) Circumferential joints:—Type of..... Riveting.....
    Diam. rivet holes.....in. Pitch of rivets....."×....."×....." Efficiency of joint.....%
    (Minimum pitch on each row.)
17. Tubes—No.....Gage..... Diam.....in. Length.....ft.....in.
18. Steam outlets:—No..... Material of nozzle or reinforcement..... **Sizes**.....in.
    (Cast steel or cast-iron, pressed steel or steel plate.)
19. Grate area.....sq. ft.
20. Size of feed connection.....in. Size of bottom blow-off connection.....in.
21. Constructed for a pressure of.....lb. per sq. in. Tested to.....lb. per sq. in.
    (Hyrostatic pressure.)
22. If boiler has a dome, send working drawing of dome, also showing connection to boiler and openings in shell under dome.

REMARKS:—.....

We certify the above data to be correct and that all details of **MATERIAL, CONSTRUCTION** and **WORKMANSHIP** on this boiler conform to the A.S.M.E. Rules.

(Signed).....
(Manufacturer.)
.....19 by.....

Received.....19 Checked.....19 by.....
Authorized State or Insurance Inspector.

Rules allow a max. pressure of.....lb., this being based on.....

FIG. 32 FRONT SIDE OF DATA SHEET FORM

CERTIFICATE OF BOILER SHOP INSPECTION

Insurance Company's Serial Number.....

BOILER WORKS OF..... at.....

I, the undersigned, holding a **certificate of competency** as an **inspector of steam boilers** in THE STATE OF....., and employed by the..... of....., inspected internally and externally, the boiler specified in this report, on..... .....19 , and certify that the statements made on this report are correct, corresponding with the mill test reports of material as furnished by the builders, and measurements made of the boiler when completed; and that this boiler is constructed in accordance with the A.S.M.E. Rules.

.....
Inspector of Boilers for State or Boiler Insurance Company.

FIG. 33 REAR SIDE OF DATA SHEET FORM

was then pointed out by those representing the Boiler Code Committee that should the range be made 10,000 lb., the physical requirements for firebox and flange steel would be identical, with the single exception that a homogeneity test is required for firebox and not for flange steel. Those representing the Boiler Code Committee were most earnest in the belief that should the tensile requirements be made the same, something should be introduced into the specifications to further differentiate between the physical qualities of the two grades.

It was proposed that as one of the essential differences between firebox and flange steel is in the amount of discard, a test of material taken from the top of the plate might be employed to show the difference between the firebox and flange grades. The samples for the bending test in the proposed revision are specified to be taken transversely from the middle of the top of the finished rolled material, and it would seem that the requirements for these cross-bending tests could be made more exacting for firebox steel than for flange steel. After considerable discussion it was unanimously agreed that the sub-committees recommend to their respective associations that the tensile range for firebox steel be made 10,000 lb. (55,000 to 65,000 lb.) and that the requirement for the bending tests for firebox steel be made more exacting than for flange steel.

It was further agreed that a recommendation be made that the diameter of the mandrel about which a specimen is bent in the bending tests should depend on the square of the thickness of the plate.

Specifications for Steel Castings

After consideration of the question of the sulphur requirement, it was the sense of the meeting that it would be inexpedient at the present time to make any change in the sulphur requirements for Class B steel castings.

ACTION OF BOILER CODE COMMITTEE

The minutes of the above meeting, which included a tentative rule for the diameter of mandrels to be used in the bending tests and a table of values for various thicknesses of plate, were approved as to form by the Boiler Code Committee at the meeting of Nov. 9. At this same meeting the Boiler Code Committee directed its Sub-Committee to take up with the Sub-Committee of the American Society for Testing Materials the advisability of making homogeneity tests for firebox steel on the samples used for the bending tests, which in the proposed revision are specified to be taken transversely from the middle of the top of the finished rolled material.

In a report upon accidents and accident prevention in machine building, which has just been completed by the Bureau of Labor Statistics, an innovation in the preparation of statistics of this character is introduced to show the seriousness of accidents as well as their frequency. For this purpose, new data are introduced under the title of "severity rates." The result is a collection of illuminating figures which show not only the number of accidents occurring in plant or industry or per thousand of employees, but also the extent to which the working forces employed have been actually incapacitated by injuries incident to their occupations.

A shaft seldom breaks all at once. The conditions that cause the break have been in existence and started the trouble a long time before the final complete rupture comes. The unintentional and undue strain on the shaft every time it jumps in the boxes and the continual heavy strain at regular intervals soon cause a crystallized condition in that part of the shaft where the greatest strain occurs. The crystallization usually begins at a point on the outer circumference of the shaft and travels toward the center. It does not necessarily—and in fact seldom does—affect the entire circumference. At this fragile point, then, a crack is started and as the crystallization grows the crack grows deeper until finally the good metal remaining, no longer able to withstand the strain, breaks. When the broken ends are examined, the fresh break shows only as far as the good metal held on. The original crack may have been started months before, and the constant motion caused the broken parts to rub together until they appear as if they had never been united. Many times the owner of the machine uses the expression, "That was never welded properly," or "The shaft was only partly welded." The common opinion or supposition that crankshafts are welded together is ill-founded. Cranks are generally either drop-forgings or steel castings or made by cutting them out of solid steel billets, and no welding process whatever enters into their formation.—*Power.*

TABLE 10 DISCHARGE CAPACITIES FOR DIRECT SPRING-LOADED POP SAFETY VALVES, WITH 45 DEG. BEVEL SEATS

Gage Press., Lb. per Sq. In.		Diameter of Valve, In.								
		1	1¼	1½	2	2½	3	3½	4	4½
15	Lb.hr.	163	203	293	456	651	977	1254	1564	1906
25	Lb.hr.	218	272	392	610	871	1307	1676	2090	2547
50	Lb.hr.	354	444	639	994	1419	2129	2732	3406	4151
75	Lb.hr.	492	615	886	1377	1968	2951	3788	4722	5756
100	Lb.hr.	629	786	1133	1761	2516	3774	4843	6038	7358
125	Lb.hr.	767	957	1379	2145	3064	4596	5899	7354	8963
150	Lb.hr.	904	1129	1625	2529	3613	5419	6954	8670	10566
175	Lb.hr.	1040	1301	1872	2913	4161	6242	8010	9984	12173
200	Lb.hr.	1178	1472	2119	3296	4709	7064	9068	11305	13773
225	Lb.hr.	1315	1643	2366	3680	5258	7890	10120	12616	15383
250	Lb.hr.	1451	1814	2613	4064	5807	8708	11175	13938	16980
275	Lb.hr.	1589	1986	2860	4448	6354	9533	12233	15248	18585
300	Lb.hr.	1746	2157	3107	4832	6903	10358	13290	16568	20195

The discharge capacity of a flat seat valve of a given diameter with a given lift, may be obtained by multiplying the discharge capacity given in the Table for a 45 deg. bevel seat valve of same diameter and same lift, by 1.4.

Society Affairs

Engineering Survey

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Miscellaneous . . . . . Page 1051

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[1] A complete list of the officers and committees of the Society will be found in the Year Book for 1917 and in the March, 1917, issue of The Journal.

SOCIETY AFFAIRS

A Record of the Current Activities of the Society, Its Members, Council, Committees, Sections and Student Branches; and an Account of Professional Affairs of Interest to the Membership

THE offices of the Society are particularly busy at this time and all the departments are carrying an overload. About 20 per cent of the membership are directly or indirectly engaged in war activities. This means that the Society is without the services of nearly 2000 members, and, as might be expected, it is always the most active ones—not only in this Society but in other organizations generally—who are the first to offer themselves for the service of their country. The result has been that many adjustments in personnel of committees and provisions for taking care of committee and section work, have had to be made.

The Committee on Meetings has lost the opportunity for consultation with Major John H. Barr, who is now in Washington in the trench-warfare division of the War Department in charge of bombing devices.

The Publication Committee has lost Prof. J. W. Roe, who is working for the Government on specifications and rules for instruction for aviation work. The Chairman of the Committee, Mr. Fred R. Low, reports that he is greatly handicapped by a depletion in his staff.

The Committee on Sections has lost Mr. Whitlock who is a Major in the Engineer Officers' Reserve Corps. The personnel of the Executive Committees of several of the Sections has been depleted by war activities.

The New York Section Committee which, in addition to its regular meetings work, is in charge of the entertainment at the forthcoming Annual Meeting, has had to get along without Messrs. Swan, Prindle and Blake. Mr. Swan has a commission in the Engineer Officers' Reserve Corps, and M.. Blake is in Washington working in the Ordnance Department.

Prof. W. B. Gregory, another member of the Council and a member of the New Orleans Section Committee, is now in France reporting directly to General Pershing. Mr. John Hunter, of the St. Louis Section Committee and Vice-President-elect, is on the Emergency Shipping Board. The Worcester Section Committee has lost two members in the persons of Messrs. Richard G. Williams and E. Howard Reed. The Erie Section has lost its chairman, Mr. J. F. Wadsworth.

Mr. George M. Brill, member of the Committee on Student Branches, is a Major in the Engineer Officers' Reserve Corps and Prof. W. D. Ennis, chairman of the Brooklyn Polytechnic Institute Branch, has a similar commission.

Mr. Park A. Dallis, chairman of the Atlanta sub-committee on Increase of Membership, is a Captain in the Engineer Section of the Officers' Reserve Corps.

Many of the special committees of the Society are depleted for this same reason of war activities. Mr. Ralph D. Mershon, member of the Research Committee, is a Major in the Engineer Officers' Reserve Corps. Prof. Lionel S. Marks, chairman of the Sub-Committee on Clinkering of Coal of the Research Committee, has been in Washington for some time as internal-combustion-engine expert for the Government.

Prof. Carl C. Thomas, member of the Research Committee and chairman of the Sub-Committee on Air Machinery of the Committee on Meetings, is now manager of machinery fabrication for the American International Shipbuilding Corporation.

Mr. Charles Day, member of the Sub-Committee on Industrial Buildings, is a member of the Production Committee of the Emergency Fleet Corporation and is now in England.

Mr. W. S. Gifford, member of the Joint Committee of Standards for Graphic Presentation, is Director of the Council of National Defense.

Mr. Edwin B. Katte, member of the Sub-Committee of Railroads, is a Major in the Engineer Officers' Reserve Corps.

These changes in committees have, of course, produced additional loads on the members left behind, but in all cases handicaps have been satisfactorily met.

Of the departments in the office, the Year Book Department has been rather severely taxed by the unusually large number of changes in addresses caused by members going into active service, coupled with the normal increase in membership in the Society, which has been sustained and has, so far, suffered no change on account of the war. The Publication Committee hopes to have the Year Book out on time and in good shape.

The Secretary's office has been unusually active in connection with the Annual Meeting which, as was anticipated, has been a very difficult one to prepare for. The Committee on Meetings is desirous of making the forthcoming convention a memorable one in the annals of the Society and at the same time bring out the service which the engineer can render the public at this critical time. Details of the program this year have been very difficult to consummate on account of the inability of prominent men to make promises in advance.

The Sections Department has also been particularly busy in maintaining this activity in the face of war conditions which have precluded many of the active Section members from contributing their normal work.

The number of callers at the office has been exceptionally heavy during the month, practically two-thirds of those coming in requesting information regarding service to our country.

The increased activity in the Employment Department, which commenced about three months ago, has been maintained and this department is taking care of at least twice the amount of its normal work. This department is coöperating with the Committee on Engineering Resources, in supplying the Government with large numbers of trained specialists.

CALVIN W. RICE,
Secretary.

The New York Alumni Associations of various colleges where technical courses are given will again hold reunions during the Annual Meeting. The following colleges are among those which have planned reunions for "College Reunion night," this year on December 7: Massachusetts Institute of Technology, Pennsylvania State College, Purdue University, Worcester, Polytechnic Institute. Other colleges will also hold these "get-together" functions, and complete announcement will be made in the final program.

ANNUAL MEETING PROGRAM

New York, December 4 to 7, 1917

TUESDAY, DECEMBER 4

12:00 m. Opening of Registration Bureau in Engineering Societies Building

12:30 p.m. Conference Luncheon, Council and Sections Delegates

2:00 p.m. Council Meeting

2:00 p.m. Meeting of Gage Committee

2:00 p.m. Sections Conference

8:30 p.m. Report of Tellers of Election and Introduction of the President-elect
Conferring of Honorary Membership upon Major-General George W. Goethals, followed by an address by Hon. William H. Taft
Reception by the President and the President-elect

WEDNESDAY, DECEMBER 5

9:45 a.m. Business Meeting: Amendments to the Constitution and By-Laws; Reports of Standing Committees; Address on the Activities of the Society for 1917, by President Hollis; Presentation to the Society of a Bust of Admiral B. F. Isherwood; Reports by Sub-Committees of the Research Committee

The consent of the meeting will be asked to adjourn the business meeting to Thursday morning in order to allow time for the addresses of the Keynote Session.

10:00 a.m. Keynote Session on THE SERVICE OF THE ENGINEER TO THE PUBLIC IN TIMES OF CRISES

UNIVERSAL PUBLIC SERVICE IN PEACE AND WAR, Dr. Ira N. Hollis, President of the Society. Other addresses will be given by distinguished men of national reputation on the following subjects relating to problems incident to the war: Coöperation of Engineers; The Agricultural Problem; The Fuel Problem; Engineering Research; Special Education in War Time; Building a Merchant Marine; Rail Transportation; Motor Transportation; The Aircraft Problem; Cantonments. This will be an all-day session.

12:30 p.m. Buffet Luncheon

2:00 p.m. Continuation of Keynote Session on The Service of the Engineer to the Public in Times of Crises

2:30 p.m. Simultaneous Sessions

POWER-PLANT SESSION

PREVENTABLE WASTE OF COAL IN THE UNITED STATES, David Moffat Myers

A COMMERCIAL ANALYSIS OF THE SMALL TURBINE SITUATION, W. J. A. London

BAGASSE AS A SOURCE OF FUEL, E. C. Freeland

THE COOLING OF WATER FOR POWER-PLANT PURPOSES, C. C. Thomas

THE STEAM MOTOR IN THE AUTOMOTIVE FIELD, E. T. Adams

GENERAL SESSION

THE TRANSFER OF HEAT BETWEEN A FLOWING GAS AND A CONTAINING FLUE, Lawford H. Fry

A STUDY OF SURFACE RESISTANCE WITH GLASS AS THE TRANSMISSION MEDIUM, H. R. Hammond and C. W. Holmberg

APPARATUS FOR COOLING, DRYING AND PURIFYING AIR, W. J. Baldwin

RECENT DEVELOPMENTS IN BALANCING APPARATUS, N. W. Akimoff.

PLOTTING BLOWER-TEST CURVES, A. H. Anderson (*By title only.*)

CROSS-CURRENT PREDETERMINATIONS FROM CRANK-EFFORT DIAGRAMS, Louis Illmer (*By title only.*)

INDUSTRIAL-SAFETY SESSION

Two codes will be presented for discussion by the Sub-Committee on Protection of Industrial Workers, on Safety Standards for Elevators and Woodworking Machinery

3:00 p.m. Meeting of Committees on Increase of Membership

3:00 p.m. Ladies' Reception and Tea

(*Continued on Next Page*)

Wednesday, December 5 (*Continued*)

4:30 p.m. Student Branch Conference

8:15 p.m. Smoker

Get-together meeting for members. Mr. John R. Freeman, Past-President Am.Soc.M.E., will give an illustrated talk upon his trip to the Orient taken last winter with Dr. John A. Brashear and Mr. Ambrose Swasey, Past-Presidents Am.Soc.M.E. Music by Glee Club. Refreshments

Thursday, December 6

9:45 a.m. Business Meeting continued, followed by General Sessions

LOCAL-SECTIONS SESSION

This session will be held under the direction of the Sections Committee, for a discussion of the work of the Sections and of Society Affairs, by representatives of the 24 Sections of the Society

GENERAL SESSION

An Account of the Engineering Work of E. D. Leavitt, F. W. Dean

An Exact Volume Regulator for Blast Furnace Engines, L. C. Loewenstein

Expenses and Costs, H. L. Gantt

The following papers contributed by Local Sections will be presented by title:

By-Product Coke and Coking Operations, C. J. Ramsburg and F. W. Sperr, Jr.

The Submarine, C. H. Bedell

Combined Stresses, A. L. Jenkins

The Trumble Refining Process, N. W. Thompson

10:00 a.m. Joint Meeting of A.S.M.E. and S.A.E. Committees on Steel Roller Chains

12:30 p.m. Luncheon, at which there will be an address on The Relation of Industrial Management to Engineering, by Prof. Dexter S. Kimball

2:30 p.m. Simultaneous Sessions

MACHINE-SHOP SESSION

Under the auspices of the Sub-Committee on Machine Shop Practice

Topical Discussion on the subject of Inspection with the following introductory discussions:

The Logic of Inspection, A. L. DeLeeuw

The Relation of Inspection to Product, F. A. Waldron

General Principles of Government Inspection and Relations Between Inspectors and Manufacturers, Col. B. W. Dunn

TEXTILE SESSION

Under the auspices of the Sub-Committee on Textiles

Labor-Turnover Records and the Labor Problem, Richard B. Gregg

Accident Prevention in the Textile Industry, David S. Beyer

The Moisture Content of Textiles and Some of its Effects, William D. Hartshorne

8:30 p.m. Lecture and Annual Reunion

The Beautiful in Commonplace Things, Dr. John A. Brashear. Following the lecture there will be a reunion and dance, with refreshments, on the fifth floor of the Engineering Societies Building

Friday, December 7

10:00 a.m. Simultaneous Sessions

MANAGEMENT SESSION

Topical discussion on the Employment of Women in the Skilled Industries, with particular reference to war conditions. To be introduced by Mr. John W. Upp, General Electric Co., and Mr. C. B. Lord, Wagner Electric Manufacturing Co.

The Engineer, the Cripple and the New Education, by Major Frank B. Gilbreth

POWER-TEST HEARING

A public hearing by the Power Test Committee, preliminary to a proposed revision of the Power Test Code of the Society, comprising rules for conducting tests on prime movers of different types, and auxiliary apparatus

2:00 p.m. Council Meeting

8:00 p.m. College Reunions

THE ANNUAL MEETING

THE Annual Meeting this year will be different from any convention ever held by the Society. Upwards of one thousand members of the Society will come together at their headquarters where a remarkable program will be carried out, but the atmosphere which will prevade the meeting rooms, the foyer, the lobbies—everywhere the members group together—will be that of the war. The discussions at the meetings, and particularly at the Keynote Session, the Machine Shop Session and the Sections Session will center on this same topic. It will be uppermost in the minds of those attending committee meetings—for the regular committees have been seriously depleted by the absence of members in active service and new committees have been appointed expressly for service to the Government at this critical time. The New York Section is not giving out the secret as yet, but even the social events of the meeting will be interspersed with patriotic exercises.

Everyone who comes to the convention will go away with impressions, not on the theory and practice of machines, nor with a better knowledge of power plants, nor of the latest developments in technical research as such, but on the practice of war—engineering war. All other questions are in abeyance at this time and the one justification for calling busy members of any large organization into convention at such a time as this is to have them bring up, discuss, settle and go away to act upon their war problems.

And what an opportunity for both gathering and disseminating information on war problems this occasion offers! Over a thousand engineers and specialists, most of whom are engaged in the vital work of the prosecution of the war will take the time to get together, not for their mutual good, but for the good of the country they have the honor to serve! Who can prescribe the limits to the benefits of this meeting? One question solved at this convention may effectualize the work of hundreds of war helpers.

Many persons have doubted the wisdom of calling large meetings at this time and the Government has expressed its general disapproval of such meetings when not essential to the public good. But the Spring Meeting of our Society in Cincinnati demonstrated strikingly that considerable benefits could accrue and no disadvantages follow from continuing the General Meetings of the Society and so there has been no question as yet of discontinuing them. We must have coöperation at this time. More than that we must have cohesion which means something much more intense, and which can only result from the most intimate contact of engineering elements. The engineers, heads of large plants putting out great quantities of munitions, supervisors of enormous tasks of providing agricultural machinery, means of transportation, aeroplanes, ships and more ships, are the elements in this case, and they must all cohere. This convention offers the opportunity and every member of the Society owes it not alone to himself, to his fellow member, nor to his Society, to attend the Annual Meeting; but he owes it to his country and to democracy.

The program of the meeting appears on the two preceding pages. Publication of the papers began in the October issue of THE JOURNAL and has been continued in the succeeding issues.

Authors of the Papers

EDWARD T. ADAMS has had a long experience in the design of large steam units and great gas-engine plants. More recently he has been chief designer for companies manufacturing modern tractors. At present his time is devoted to investigations of the use of steam, heavy oil and gasoline engines in the automobile and other fields.

NICHOLAS W. AKIMOFF has specialized in various applications of dynamics to mechanical engineering. His first paper on Dynamic Balance was presented to the Society at the Spring Meeting, 1916. His recent book on Lagrange's Equations was reviewed in THE JOURNAL.

A. M. ANDERSON, during his thirteen years' connection with the Armour Institute of Technology, has been instrumental in the development of a new form of pitot tube for air and gases. His other engineering activities have been principally in pneumatics and hydraulics, covering determinations of velocities in ventilation ducts, compressed-air pipes, gas pipes, and water meters, current meters, and anemometers.

WILLIAM J. BALDWIN was a member of the Society's Committee which first formulated the American Standard Pipe Thread, the Briggs formula, and it was he who was responsible for bringing the Briggs system to the attention of the committee. He has been engaged in consulting-steam-engineering practice in New York City for many years, and the apparatus for mechanically drying air described in his paper is the result of his experiments to overcome and abate the smoke and dust nuisance in Manhattan.

C. H. BEDELL was for twenty years head of the electric laboratory of the Electro Dynamic Company, during which time the inter-pole adjustable-speed motor was developed. For the last nine years he has served as electrical engineer for the Electric Boat Co.

DAVID S. BEYER was for eleven years in charge of technical survey of plants and fire insurance, and later chief safety inspector of the American Steel & Wire Co. He is the author of a number of papers on accident prevention. He presented a paper on Recent Application of Safety Devices for Textile Machinery at the annual congress of the National Safety Council in New York this year.

ADOLPH L. DELEEUW writes from a very extended experience, having been designing engineer with the Niles Tool Works Co., mechanical engineer with the Cincinnati Milling Machinery Co., and at present is mechanical engineer with the Singer Manufacturing Co. He has written quite a number of papers on the important subject of metal cutting and metal cutters.

F. W. DEAN, who writes on the work of Mr. E. D. Leavitt, was associated with Mr. Leavitt for several years. Since that time he has been practising mill engineering and architecture in Boston, dealing with mill construction, steam plants, water power, and general consulting and expert engineering. Since the date of his joining the Society in 1883 Mr. Dean has contributed voluminously to its proceedings.

LAWFORD H. FRY is now general inspector of the Standard Steel Works Co. In 1908 he contributed to the Institution of Mechanical Engineers a paper on Combustion and Heat Balances in Locomotives, which was one of the first analyses made of the experiments on the Pennsylvania Railroad locomotive-testing plant. Since then he has contributed a number of papers to technical societies and to technical journals dealing with various aspects of locomotive operation, paying particular attention to the action of the boiler. His later work has been largely connected with the heat-treatment of steel.

HENRY L. GANTT, consulting enigneer, was associated with the late Frederick W. Taylor in the initial stages of development of the latter's system of industrial management, and for more than the past ten years has given his professional attention to administration, management, and other subjects which confront the

industrial engineer. He has presented many valuable papers on management and kindred topics before the Society, and has otherwise embodied his ideas in published works that have become a part of the authoritative literature on the subject.

FRANK B. GILBRETH, now a Major in the Engineer Officers' Reserve Corps, has been particularly active of late in connection with the problem of taking care of soldiers crippled in the war, and using them in the industries. Mr. Gilbreth was recently successful in securing official recognition of this work, and is now devoting his whole time to this problem.

RICHARD B. GREGG was during the summer of 1916 in direct charge of an investigation into the hours, wages and working conditions of some 500 shops in the dress and waist industry of New York City. In addition to consulting and organizing work, he has thoroughly studied for the employers the labor situation in a number of textile mills and establishments in other industries.

WILLIAM D. HARTSHORNE can claim a thirty-four years' experience with textile-mill conditions. For twenty years of this period he was employed in the respective capacities of chemist, manager of dyeing and finishing department, and as general superintendent of the worsted department of the Arlington Mills at Lawrence, Mass. For the last fourteen years of this service he was resident agent of the Textet Corporation, covering both worsted and cotton departments. He has contributed a number of papers concerning textile-manufacturing problems and mill conditions to the proceedings of several societies.

LOUIS ILLMER, who has specialized as gas and oil-engine expert for the past fifteen years, is now engaged in high-speed development work for Mr. Simon Lake, the submarine expert at Milford, Conn. Prior to this work, he developed the Illmer gas-engine and complete producer-plant equipment for the Reading Iron Co., Reading, Pa. The results of some of his rather extensive research studies into the fine points of engine design are embodied in a number of papers.

A. LEWIS JENKINS, of the University of Cincinnati, has made a number of contributions on the strength of punch and riveter frames, and stresses due to bending and twisting, and has done considerable work on the stress relations in pressed fits. He was the first to publish the present accepted formulæ for the design of pressed fits. He has written several articles on hydraulic presses, intensifiers, accumulators and pumps.

LOUIS C. LOEWENSTEIN has had a varied experience in designing machinery for marine use with several large shipbuilding and other concerns. He was for six years in charge of instruction of machine design and steam-engineering subjects at Lehigh University. Since 1907 he has been engaged in design and theoretical engineering of steam turbines and centrifugal compressors with the General Electric Co., at Lynn, Mass.

W. J. A. LONDON served his apprenticeship with Sir Charles A. Parsons on turbine work and was later connected with the Brown-Boveri Co., in Switzerland doing the pioneer work of introducing steam turbines on the continent. He was at one time special research engineer on turbine work for Mr. George Westinghouse, and was for seven years chief engineer of the Terry Steam Turbine Co. He is at present engaged in developing a new design of steam turbine known as the steam motor.

CHESTER B. LORD, general superintendent of the Wagner Electric Co., has had a long connection with the construction, layout and equipment of new plants. He was for six years general foreman in charge of tools, dies and special machines of the General Electric Co.

DAVID MOFFAT MYERS is a member of the firm of Gregg & Myers, Consulting Engineers of New York City. He has devoted much attention to the use of special fuels, such as tan-bark, chestnut-chips and bagasse, especially in the plants of the United States Leather Co.

CHARLES J. RAMSBURG was connected for seventeen years with the United Gas Improvement Co., of Philadelphia, in various capacities, and for nine years as assistant engineer of works in charge of daily operation of Philadelphia gas works. He has presented numerous papers before the American Gas Institute on general technical subjects connected with the gas industry, and was awarded the Beal Medal by the Institute in 1910 for his paper on Gas Purification. He became associated with H. Koppers Co., in 1913 in the capacity of vice-president, and since that time has contributed a number of papers on by-product coke-oven subjects.

FREDERICK W. SPERR, JR., now chief chemist of the H. Koppers Co., started in the by-product coke-oven business in 1910 as a chemist for the first plant of Koppers ovens in America,—the plant of the United States Steel Corporation at Joliet, Ill. He has subsequently been chief chemist of the Fairfield plant of the Tennessee Coal, Iron & Railroad Company and of the blast furnace and coke department of the Inland Steel Company, both of these companies operating Koppers plants.

CARL C. THOMAS was for a number of years on the Atlantic Coast in charge of marine-machinery design at the Maryland Steel Co., Sparrows Point, and connected with building of merchant and naval vessels. He was called to Cornell University as professor of marine engineering in 1904, to the University of Wisconsin as professor of steam engineering in 1908, and to Johns Hopkins University in 1913 as head of the Department of Mechanical Engineering, from which institution he is now on leave of absence. He is the inventor of the Thomas meter, which has been described in the TRANSACTIONS of the Society.

JOHN W. UPP has been connected with the General Electric Co., at Schenectady, for seventeen years. He began in the engineering department and was later placed in charge of the drafting department; he is now manager of the switchboard department. He is a member of the Society's special committee on Standard Cross-Sections and Symbols.

FREDERICK A. WALDRON has had experience with the Brown & Sharpe Manufacturing Co., Beaman & Smith and the Yale & Towne Manufacturing Co. With the last mentioned company he worked his way up to the position of superintendent. He has been practising as an industrial engineer for some years, and is chairman of the sub-committee on Industrial Buildings of the Society.

Power Test Hearing

On Friday morning, December 7, of the Annual Meeting there will be one of the most important sessions in respect to standardization that this Society has ever held. This will be a public hearing by the Power Test Committee, held in pursuance of a requirement of the Council that this Committee should hold meetings from time to time at which interested parties may have an opportunity to present suggestions for purposes of revision.

The Power Test Codes were formulated by the Power Test Committee in 1915 and were published in Volume 37 of the TRANSACTIONS. They comprise rules for conducting performance tests on boilers, engines, turbines, pumps, compressors, blowers, complete steam plants, locomotives, gas-power apparatus and water wheels.

The Power Test Committee will welcome a thorough discussion of the Rules in the hope that they may be made of the greatest value to manufacturers and users of power-plant apparatus and to the profession generally.

The different sections of the Codes will be taken up in detail to facilitate suggestions which later will be considered by the Committee as material for the revision of the Codes.

Invitations have been extended to over fifty societies to send delegates, and colleges, railroads, manufacturing firms, and testing laboratories have also been asked to send representatives.

REPORTS OF STANDING COMMITTEES

THE reports of Standing Committees of The American Society of Mechanical Engineers will be presented at the forthcoming Annual Meeting as an appendix to the Annual Report of the President of the Society's activities for the year. The Standing Committee reports are published below:

Reports of Finance Committee

The Finance Committee reports that the income of the Society for the year ending September 30, 1917, was $207,046.98. The total expenditures chargeable to income were $186,547.57, leaving an excess of income over expenditures of $20,499.41, this being a net balance after reserving $14,000 for obligations undertaken but not yet completed.

The expenditures of the Society per member for the fiscal year just closed are as follows:

General Salaries	$ 2.06
Headquarters, Library, Supplies, etc	1.84
Committees on Membership and Increase of Membership	1.27
Sections	.98
Council contingencies, mileage and employment	.77
House Committee	.40
Meetings, Annual and Spring	1.18
Year Book	.63
Journal and Condensed Catalogues	8.47
Transactions	2.42
Other activities	2.73
Making a total of	$22.75

The recommended Budget Appropriation for the year 1917-1918 is as follows:

Finance Committee		
Administrations	$ 22,700	
Occupancy of Building and Engineering Council	8,800	
Library	4,000	
		$ 35,500
Membership Committee		2,900
Council		
Contingencies	3,000	
Committees not otherwise provided for	6,700	
Mileage	2,200	
Employment Bulletin	2,400	
		14,300
Sections Committee		10,750
Increase of Membership Committee		8,300
House Committee		4,335
Meetings Committee		10,265
Publication Committee		104,405
Research Committee		500
Students' Committee		1,000
Junior Prizes Committee		75
Sales Expenditures		11,000
John Fritz Medal Board of Award		75
Engineering Resources Committee		1,500
Coöperation and Organization Committee		100
Public Relations Committee		500
Total		$205,505

The estimated income for the year 1918 is $228,500.

Appended will be found reports of the accounts of the Society as shown in the books for the fiscal year ending September 30, 1917.

Respectfully submitted,

R. M. Dixon, *Chairman*,
A. E. Forstall,
Geo. M. Forrest,
W. D. Symons,
Finance Committee.

REPORT OF ACCOUNTS

Mr. R. M. Dixon,
Chairman, Finance Committee.

Dear Sir:

In accordance with your instructions, we have examined the books and accounts of The American Society of Mechanical Engineers for the twelve months ended September 30, 1917.

The results of this examination are set forth in the three exhibits attached hereto, as follows:

Exhibit A Balance Sheet, September 30, 1917.
Exhibit B Income and Expenses, for the twelve months ended September 30, 1917.
Exhibit C Receipts and Disbursements for the twelve months ended September 30, 1917.

We hereby certify that the accompanying Balance Sheet is a true exhibit of its financial conditions as of September 30, 1917, and that the attached statements of Income and Expenses, and Receipts and Disbursements, are correct.

Respectfully submitted,

(Signed) Wm. J. Struss & Co.,
Certified Public Accountants.

EXHIBIT A

Balance Sheet, September 30, 1917

RESOURCES

Equity in Society's Building (No. 25 to 33 West 39th Street)	$365,846.62	
Equity in one-third of Cost of Land (No. 25 to 33 West 39th Street)	180,000.00	
		$545,846.62
Library Books	13,000.00	
Furniture and Fixtures	5,000.00	
		18,000.00
Stores, including plates and finished publications		25,809.91
Trust Funds Investment		
New York City 3½'s 1954 (par $45,000)	39,696.81	
St. Louis, Peoria & N. W. 1st 5's 1948 (par $10,000)	10,613.89	
United New Jersey Canal Co. (par $1,000)	970.00	
Cash in Banks representing Trust Funds	4,510.51	
		55,791.21
City of East Orange, Loan Certificate		21,371.95

Liberty Bonds, Investment	10,000.00	
Liberty Bonds, Accounts	1,599.00	
		11,599.00
Accounts Receivable		
Membership Dues	14,015.73	
Initiation Fees	6,430.00	
Sales of Publications, Advertising, etc.	34,840.52	
		55,286.25
Advance payments		2,734.06
Cash: In Banks for general purposes	31,890.64	
Petty Cash, on hand	500.00	
		32,390.64
		$768,829.64

LIABILITIES

Trust Funds		
Life Membership Fund	$45,595.15	
Library Development Fund	4,902.71	
Week's Legacy Fund	1,957.00	
Melville Fund	1,127.36	
Hunt Memorial Fund	208.99	
Junior and Student Prize Funds	2,000.00	
Total		$ 55,791.21
Dues paid in advance		2,167.07
Initiation Fees uncollected		6,430.00
Replacement Fund		1,336.70
Internal Revenue		1.40
Accounts Payable		2,917.26
Annual Meeting Social		9.11
		68,652.75
Unexpended Appropriation 1915-1916	267.35	
Unexpended Appropriation 1916-1917	16,684.79	
Unappropriated Revenue	17,814.62	
		34,766.76
Capital Investment	551,346.62	
Surplus and Reserve	114,063.51	
		665,410.13
		$768,829.64

EXHIBIT B

INCOME AND EXPENSES FOR THE TWELVE MONTHS ENDED SEPTEMBER 30, 1917

INCOME

Membership Dues		$110,493.65
Sales—Gross Receipts		14,437.89
Advertising		63,927.96
Interest and Discount		4,707.48
Initiation Fees		13,480.00
Total		$207,046.98

EXPENSES

Finance Committee		
Office Administration	$21,614.53	
Occupancy Building	6,432.36	
Library	4,016.67	
		$ 32,063.56
Membership Committee		3,062.11
Council		
Contingencies	2,673.02	
Mileage	1,564.38	
Employment Bulletin	2,063.61	
		6,301.01
Increase of Membership Committee		7,328.76
House Committee		3,244.28
Meetings Committee		9,672.70
Sections Committee		8,058.65
Publication Committee		
Advertising	35,665.93	
Journal Text	33,766.63	
Revises	433.72	
Transactions	19,710.00	
Year Book	5,148.89	
		94,725.17
Sales		
General	8,093.70	
Boiler Code	2,942.77	
Power Test Code	550.79	
		11,587.26
Research Committee	261.43	
Students' Committee	1,199.47	
Junior and Student Prizes	70.38	
John Fritz Medal	77.04	
Coöperation and Organization	83.75	
Engineering Resources	1,432.50	
Alterations on Building	7,379.50	
		10,504.07
[1] Total		186,547.57
Excess of Income over Expenses		$20,499.41

EXHIBIT C

RECEIPTS AND DISBURSEMENTS FOR THE TWELVE MONTHS ENDED SEPTEMBER 30, 1917

RECEIPTS

Membership Dues	$107,359.87	
Initiation Fees	26,925.00	
Membership Dues paid in advance	2,789.69	
Sales of Publications, Badges, Advertising, etc	72,962.59	
Interest	5,431.02	
Liberty Bonds	851.00	
	$216,319.17	
Cash on hand and in Banks General and Trust Funds, September 30, 1916	51,352.14	
		$267,671.31

DISBURSEMENTS

Disbursements for General Purposes	$184,448.21	
Building Improvement	12,500.00	
City of East Orange Loan	21,371.95	
Liberty Bonds	12,450.00	
	$230,770.16	
Cash on hand and in Banks General and Trust Funds, September 30, 1917	36,901.15	
		$267,671.31

[1] NOTE: The item of total expenses includes $14,000 not yet paid to complete work already in progress and chargeable to this year's activities.

Report of Committee on Meetings

Professional Sessions

Although it has been the aim of the Meetings Committee to maintain a high standard for papers presented and discussed at the professional sessions of general meetings, the Committee has realized that many members of the Society regard of equal importance the opportunities afforded for personal conferences, for special committee meetings, for discussion of problems of peculiar interest to a limited number only, and for bringing about a personal contact among the members of the Society that is becoming truly national. With these points in view the Committee has ever before it the idea of so balancing the programs at the meetings that they shall not be overburdened with detailed technical papers, and would emphasize as a guiding principle for the future the wisdom of somewhat limited, carefully chosen programs stimulating general discussion, in preference to sessions overburdened with an unduly large number of papers.

Keynote Session

Besides a number of professional sessions devoted to the interests of various specialties of the members, it has been the aim of the Committee for the past few years to have during each Annual and Spring meeting a so-called "keynote" session which should offer an opportunity for the presentation of the broad but timely problems of general interest. With these points in mind, Industrial Valuation was chosen as the general theme for the keynote session of the Annual Meeting, December 1916.

As the Spring Meeting of 1917 came shortly after the declaration of war, the Committee felt that perhaps the most timely subject was the manufacture of munitions. The large attendance at the Cincinnati meeting is in part attributed to the announcement of this important subject and partly to the exceptional opportunity afforded the members of the Society to coöperate with the members of the National Machine Tool Builders' Association, with whom a joint session was arranged.

So important has become the relation of the engineer to the problems resulting from the war that the Committee has chosen for the keynote session of the coming Annual Meeting, December 4 to 7, 1917, Service of the Engineer to the Public in Times of National Crises.

Special Exercises

In connection with the Annual Meeting, December 1916, special memorial exercises were held in honor of John E. Sweet, the beloved founder of the Society.

At the coming Annual Meeting, December 1917, there will be special exercises in connection with the conferring of honorary membership upon Major-General George W. Goethals, upon which occasion the address of the evening will be delivered by William H. Taft, ex-President of the United States.

Social Functions

At the Annual Meeting of 1916 all social events were held in the Engineering Societies Building. Owing to this fact the democratic spirit of the Society was more keenly developed, as more freedom was felt on the part of the members and guests in attending these various functions. The spirit of good fellowship thus promoted is a distinct asset to the Society.

The success of the smokers held the last two years has prompted the Committee to arrange for the repetition of this part of the program for the Annual Meeting of 1917, with such modifications as past experience has shown would be desirable.

The delightful functions provided in connection with the Spring Meeting at Cincinnati were all in accord with the aims of the Committee on Meetings to promote the most cordial democratic spirit among the members.

Inspection Trips

It is the belief of the Committee that inspection trips to various points of engineering interest should be continued in connection with both the Annual and the Spring Meetings. It is the feeling of the Committee, however, that a small number of such trips thoroughly organized is distinctly more beneficial and pleasanter for the membership than a large number of informal trips, offering too large a variety of opportunities.

Attendance at Meetings

Evidences of the broader field of activity of the Society are apparent in the attendance at the Annual and Spring Meetings. The total registration at the Annual Meeting, December 1916, was 1868, the largest in the history of the Society. Of this number 953 were members and 915 were guests. The number of members present represented 12.5 per cent. of the total membership, and exceeded that of the Annual Meeting of 1915 by 431.

It is somewhat more difficult to compare the figures of attendance at the Spring Meetings, owing to the fact that the geographical location of the meeting has a distinct bearing upon attendance, but it is interesting to note that the attendance at Cincinnati in 1917 broke all previous spring-meeting records, the total registration being 868, of which 410 were members and 458 guests.

Sub-Committees of the Meetings Committee

The work of the sub-committees of the Committee on Meetings has for the most part been exceedingly satisfactory. It stimulates a wide interest in the work of the Society and results in the presentation of excellent papers and discussions. The Committee feels that it is wise to continue those sub-committees that keep alive and awake to their opportunities, but it also believes it unwise to appoint too many such committees on account of the danger of overspecialization and the possibilities of unwieldly programs.

Respectfully submitted,

Robert H. Fernald, *Chairman*,
L. P. Alford,
John H. Barr,
Dexter S. Kimball,
A. L. De Leeuw.
Meetings Committee.

Report of Publication Committee

During the year The Journal has been developed by extending the Engineering Survey to include engineering activities outside of those of our own or other societies, especially in the way of engineering research. The Review of Engineering Periodicals has been broadened to include publications in English as well as in the foreign languages. Reviews, written by specialists in their several fields, have been published of

notable additions to the literature of our subject. Mr. C. M. Sames has been added to the editorial staff. The makeup and distribution of THE JOURNAL for the first seven months of 1917 were as follows:

MAKEUP OF THE JOURNAL, 1917

Technical Section	48 per cent
Society Affairs	19 per cent
Engineering Survey	33 per cent
	100 per cent

DISTRIBUTION OF THE JOURNAL, 1917

To Members	8250 copies per month
Exchanges	250 copies per month
Subscriptions	450 copies per month
Advertisers	300 copies per month
Students	500 copies per month
	9750 copies per month

The cost of publishing THE JOURNAL for the fiscal year ending October 31, 1917, was about $53,428, and its income from advertising about $34,928, leaving a deficit of about $18,500. No credit is given to THE JOURNAL for copies sold to subscribers and furnished, in partial return for their dues, to the membership and student branches. These, furnished at present to the number of over 9000, at $3.00 per year to subscribers and $2.00 to the membership, would more than cover the apparent deficit and show THE JOURNAL to be paying its own expenses.

It is the purpose of the Committee to make THE JOURNAL an epitome of current information in the field of mechanical engineering, and to devote to this service whatever revenue the paper may produce.

The last issue of Condensed Catalogues cost about $15,500 and brought in a revenue of about $29,000, making a profit of about $13,500. It has been improved by the addition of an index of manufacturers of mechanical equipment.

In 1913 the Committee was allowed an appropriation of $750 for indexing the TRANSACTIONS. To this has been added $350, making $1100 in all. It was pointed out when these appropriations were asked for that they would meet the expenses only of preparation, but not of publishing. We are now able to report the complete indexing of TRANSACTIONS from Volume I to date in card form. To publish this in book form will cost about $2000 plus 90 cents per copy, thus:

ESTIMATED COST OF TRANSACTIONS INDEX

For 2000 copies	$2000
2000 x 90 cents	1800
	$3800
For 10,000 copies	$2000
10,000 x 90 cents	9000
	$11,000

These ought to be furnished free to the membership as they have been in the past, and we recommend that the Committee be authorized to expend not to exceed $2000 in printing it with a view to its distribution when the necessary funds become available.

It has been the practice of the Society to preserve all undistributed copies of TRANSACTIONS and of the separate papers. The accumulation is becoming burdensome, and the Committee has decided to retain not over 25 copies of each volume of the TRANSACTIONS up to and including Vol. XXV and 100 copies each of Vols. XXVI to XXXIII inclusive. Several of the earlier volumes are completely exhausted and the Society is seeking them at a premium. No more than the reserved number of any volume are on hand in the bound form. The surplus will be sold to those desiring them at $2.50 per volume in paper covers, or at $2.00 gathered and stitched ready for binding.

With the increased appropriation at the disposal of the Committee for the coming year, we hope to make the publications of the Society, especially THE JOURNAL, of still greater benefit to the membership.

Respectfully submitted,

FRED. R. LOW, *Chairman*,
C. I. EARLL,
GEORGE J. FORAN,
FRED. J. MILLER,
JOSEPH W. ROE.
Publication Committee.

Report of Standardization Committee

The Standardization Committee is charged with a general oversight of the standardizing activities of the various committees within the Society. That means that it does not concern itself with any of the details of the actual work of standardizing, but rather with the work being carried on by other committees according to a general routine and principles adopted by the Society. It concerns itself further with the promotion of interrelation of the activities of the various committees where that seems advisable.

In carrying out its duties this Committee has interpreted its mandate to exercise the least possible authority so far as committees were concerned that were appointed before its creation.

With regard to committees appointed after the creation of this Standing Committee, the latter has confined itself strictly to suggestions made directly to the Council as to the personnel and general routine activities of the various special committees.

The most important activity of the Standardization Committee has been its work in connection with the creation of an American Engineering Standards Committee. Active in this work were jointly the American Society of Civil Engineers, the American Institute of Mining Engineers, The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials. Delegates from these societies created an Executive Committee consisting of one member from each and this committee reported a Constitution and By-Laws to the main Joint Committee, which latter accepted the report and caused it to be sent to the founder societies for their action.

Approval was given to this by all except the American Society for Testing Materials, and that approval is expected as soon as its governing body meets this fall. A copy of the American Engineering Standards Committee's Constitution and By-Laws is appended. A careful study of this Constitution is recommended, as it is probably the beginning of what is hoped will eventually fill a very important national and international need. It is expected that with time every technical association or society, whether of an engineering or other nature, not only in the United States, but abroad, will participate in the work of this committee. A beginning in this direction has already been made in that the British Engineer-

ing Standards Committee has invited this American Engineering Standards Committee to send delegates to London to consider a change in the British standard Whitworth thread to the simpler cross-section of the United States screw thread, and to consider also the question of metric threads.

It is gratifying to note that the suggestions made by the predecessor of our own Committee while that was a special committee on standardization, formed the basis in the formulation of the Constitution of this American Engineering Standards Committee and have to a considerable extent been adopted by it.

Respectfully submitted,

HENRY HESS, *Chairman.*
H. L. GANTT,
W. F. KIESEL,
CARL SCHWARTZ.
Standardization Committee.

Report of Library Committee

Your Library Committee has the honor to present the following report for the year ending September 30, 1917.

As the library of the Society has been incorporated in the United Engineering Society Library, the duty of the Committee has been to represent the Society on the Library Board of that organization, and this report summarizes briefly the work of the United Engineering Society Library during the year.

The Library contained 49,702 volumes and pamphlets on October 1, 1916, and 132,070 on September 30, 1917. The extraordinary increase is due to the absorption of the library of the American Society of Civil Engineers which occurred in February 1917, and which added 67,242 volumes and pamphlets to the collection. Of the current accessions, 206 were presented through THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

In March, Mr. W. P. Cutter presented his resignation as Librarian, which was accepted. Mr. H. W. Craver, Librarian of the Carnegie Library of Pittsburgh, was elected to fill the vacancy, and assumed the duties of the position on April 1. The title of the position was changed to Director of the Library at this time.

The number of readers during the year was 12,710.

In addition, the Library Service Bureau has met the needs of inquirers by preparing bibliographies and translations, and by copying articles. This branch of the work shows a steady gain in volume as engineers become more familiar with its advantages.

Respectfully submitted,

JOHN W. LIEB, *Chairman,*
JESSE M. SMITH,
WALTER M. MCFARLAND,
A. M. HUNT,
CALVIN W. RICE.

Report of Membership Committee

The Membership Committee held nine meetings during the year 1916-1917.

The number of applications considered in the transaction of its work and a summary showing the action taken, follows:

Applications pending October 1, 1916	700
Applications received during the fiscal year	1695
Total	2395

The following action was taken on these applications:

Recommended for membership	1494
Recommended for membership (special cases)	15
Deferred indefinitely	7
Deferred	11
Denied promotion	5
In regular course of procedure	863
Total	2395
Reinstatements and reconsiderations pending	18

Those recommended for membership were divided into the following grades:

Members	412
Promotion to Member	75
Associates	115
Promotion to Associate	2
Associate-Members	342
Promotion to Associate-Member	43
Juniors	505
Total	1494

The reinstatement of thirteen members was recommended to the Council.

Under B 16, it was recommended to the Council that the dues of seven members be permanently remitted.

Respectfully submitted,

HOSEA WEBSTER, *Chairman,*
JAMES W. NELSON,
S. D. COLLETT,
W. C. MORRIS,
NICHOLAS S. HILL, JR.
Membership Committee.

Report of House Committee

The report of the House Committee for last year referred to certain building additions and alterations, which made it necessary to hold the Annual President's Reception on the fifth floor of the Engineering Societies Building instead of in the Society's rooms. This function was very satisfactorily carried out, judging from the comments of members and guests who attended the reception, and no doubt future receptions can be held in the same manner and place, with equally good results.

The changes in the Board Room referred to in last year's report have been made, but it has been considered advisable to withhold redecorating this room and hall, or lobby, until the contractors for building changes have completed this work, on account of the dust which accumulates through the building. It is hoped that this work can be completed before the Annual Meeting in December 1917.

It has been found necessary to make certain extensive alterations in the working offices of the Society's quarters, with a view to providing more room and far better facilities for lighting, arrangement of desks for employees, intercommunication and acoustic properties. These changes are well under way and should be completed by October 1, 1917. The expense involved is about $6600, but no doubt will prove to be one of the best investments the Society ever made.

During the year the Society received as a gift from Miss Hoadley a most excellent oil portrait of Past-President J. C. Hoadley. This has been hung on the wall of one of the Society's rooms.

Of Past-Presidents' photos, that of Dr. D. S. Jacobus has

been received and added to the Society's most excellent collection.

Respectfully submitted,

FREDK. A. SCHEFFLER, *Chairman*,
JAMES W. NELSON,
ORRIE P. CUMMINGS,
H. O. POND,
MAXWELL W. UPSON.
House Committee.

Report of the Committee on Constitution and By-Laws

The Committee on Constitution and By-Laws, at meetings held January 19, March 26, and April 16, 1917, discussed various proposed amendments and additions to the Constitution and By-Laws of the Society, and subsequently recommended changes to the Council. These amendments were approved by the Council on April 20, and were presented at the Spring Meeting in Cincinnati in May.

In accordance with C57, the amendments to the Constitution were published in the October issue of THE JOURNAL. They will be presented for discussion and final amendment at the forthcoming Annual Meeting and will subsequently be sent to all members entitled to vote, and the final vote of adoption will be closed on March 4, 1918.

Some of the changes in the Constitution necessitated changes in the By-Laws which have also been recommended to the Council and were approved on October 12, as well as new By-Laws for Professional Sections, Local Sections, etc.

The By-Laws governing Local Sections are the combined effort of about two years' work on the part of the Committee on Constitution and By-Laws and the Committee on Sections, and were framed to conform with all phases of the Local Sections' work to be found in different parts of the country, to afford the Sections every opportunity to carry on activities of local interest and at the same time to have their procedure in conformity with the Constitution and the By-Laws of the Society. These amendments are appended to this report.[1]

The changes in the By-Laws made necessary by the amendments to the Constitution and the new By-Laws, including those governing the Professional Sections, are also appended.

The Committee has also under consideration modifications to the By-Laws to provide for the decision of the Council to suspend the dues of members in active service for the period of the war and for six months after peace is declared, and also to exempt from dues a member reaching the age of seventy years, and who has paid dues for thirty-five years.

Respectfully submitted,

F. R. HUTTON, *Chairman*,
IRA H. WOOLSON, *Secretary*,
JAMES E. SAGUÉ,
GEORGE M. BASFORD,
JESSE M. SMITH.

APPENDIX

CHANGES IN THE BY-LAWS NECESSITATED BY CHANGES IN THE CONSTITUTION

The Committee on Constitution and By-Laws recommends that the By-Laws governing the Library Committee, the House Committee and the Research Committee be amended, and that new By-Laws governing the Public Relations Committee, the Standardization Committee and the Constitution and By-Laws Committee be provided, as follows:

Committee on Library

B 24 There shall be a Standing Committee on Library to consist of four Members and the Secretary of the Society. One of the four Members shall be appointed by the President before the first day of each calendar year to serve for four years.

It shall be the duty of the Committee to represent the Society on the Library Board of the United Engineering Society.

The Committee shall deliver to the Secretary before October 15 of each year a detailed report of its work for the preceding twelve months and also of the work which it recommends for the next fiscal year, with an estimate of the cost thereof.

House Committee

B 25 There shall be a Standing House Committee to consist of five persons who shall be Members, Associates, Associate-Members or Juniors. The term of office of one Member of the Committee shall expire at the end of each Annual Meeting. It shall be the duty of the House Committee to have the care, management and maintenance of the rooms of the Society and furnishings, the historical relics, the paintings, and objects of art, and to recommend to the Council suitable regulations for their care and use. At the end of each fiscal year the Committee shall deliver to the Secretary a detailed report of its work.

Research Committee

B 43 There shall be a Standing Research Committee to consist of five Members, Associates, Associate-Members or Juniors. The term of office of one member of the Committee shall expire at the end of each Annual Meeting.

(*a*) This Committee shall have supervision of such research or investigations as may be directed or approved by the Council; shall correspond and collaborate with committees of kindred technical, scientific or other societies; shall keep in touch with researches conducted in other countries, which are of value to the engineer, and shall report the same quarterly to the Council.

(*b*) The Committee will be expected to maintain a system of announcement of results of research and the trend of investigations in any field which will be of value to the engineering profession.

(*c*) Gifts or bequests to the Society for the conduct of research or investigation shall be expended under the direction of the Council, and shall be kept separate from other Society funds.

Public Relations Committee

B ? There shall be a Standing Public Relations Committee to consist of five persons who may be members in any grade. The term of office of one member of the Committee shall expire at the end of each Annual Meeting.

It shall be the duty of the Committee to consider and report to the Council its recommendations covering any matters which may be referred to it bearing upon the relations of the engineer as a man of science to the community in which he lives.

Committee on Standardization

B ? There shall be a Standing Standardization Committee to consist of five Members of the Society. The term of office of one member of the Committee shall expire at the end of each Annual Meeting. It shall be the duty of this Committee:

(*a*) To formulate and revise standards of principle, method or procedure, in engineering practice.

[1] Published in THE JOURNAL, November 1917, p. 940.

(*b*) To coöperate with like committees of bodies of kindred aim, or with members of the Society, in the formulation and revision of standards; or to appoint under approval of the Council committees of experts in specialized subjects to coöperate with them. The Chairman may represent the Committee on Standardization in any conferences.

(*c*) To report to the Council with its recommendation any formulated standards for its approval, and when approved to present and recommend such standards to the meetings of the Society, and secure this publication in THE JOURNAL and TRANSACTIONS of the Society.

Committee on Constitution and By-Laws

B ? The Committee on Constitution and By-Laws shall consist of five persons who shall be Members of the Society. The term of office of one member of the Committee shall expire at the end of each Annual Meeting.

It shall be the duty of the Committee to consider and report on all matters relating to the Constitution, By-Laws and Rules of the Society which shall be referred to it.

NEW BY-LAWS

It was recommended that the existing Rules 17 to 24 inclusive, defining the functions of Professional Sections and Geographical Groups, be changed to a By-Law, and that they be amended to read as follows:

Professional Sections

B ? (*a*) A professional Section of the Society shall consist of Honorary Members, Members, Associates, Associate-Members and Juniors of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and of other persons to be designated Affiliates as hereinafter described.

(*b*) A Professional Section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS may, with the approval of the Council, be organized for the consideration of any engineering, scientific, or professional topic, provided that a number satisfactory to the Council, of Members of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, unite in making written request for such an organization. Such a section shall be designated as . . . Section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS—the blank being filled by the topic specialized.

(*c*) The provisions of the Constitution, By-Laws and Rules of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, and the precedents of the Society with respect to professional sessions for the discussion of papers, shall cover the procedure of the Professional Sections except that no meeting of a section shall be considered a meeting of the Society as a whole.

(*d*) For the convenient conduct of its professional affairs the section shall organize an Executive Committee of five members of the Society, under the general direction of the Council. Such officers as the section shall require must be selected from the membership of the Society. Other committees of the section shall be appointed by its Executive Committee.

(*e*) The Executive Committee of the section, subject to the approval of the Secretary of the Society, shall designate a Secretary of the section whose duties shall be those usually attaching to the Secretary of a professional section, and who shall also see that the discussions of papers are satisfactorily reported and transmitted to the Secretary of the Society.

(*f*) Expenditures for the purpose of a section chargeable to the Society must be authorized by the Secretary of the Society before they are incurred, and must be provided for in the budget approved by the Council. No liability otherwise incurred shall be binding on the Society. Any expenditure not so provided must be met by the section itself.

(*g*) Engineers and others not members of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, but desiring to participate in the meetings of the section may enroll themselves as Affiliates as heretofore provided, with the approval of the Executive Committee of the section. Such Affiliates shall have the privilege of presenting papers and taking part in the discussions. They shall pay $5 per annum, which shall be due and payable in advance on October 1 of each year of their enrollment, and shall thereby be entitled to receive the regular issues of THE JOURNAL for a period covered by such subscription.

(*h*) The Council of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS may, at sixty days' notice, suspend or disband any section.

Quorum at Council Meetings

B ? The number of persons constituting a quorum of the Council shall be one-third of the number of members of the Council then in office.

Committee on the Washington Award

B ? The Committee on the Washington Award shall consist of two members appointed by the Council to serve for a term of two years. The term of office of one member of the Committee shall expire at the close of the Annual Meeting of the Society in each year. The appointment to fill a vacancy shall be made before January 1 in each year.

This Committee shall coöperate with the Western Society of Engineers in selecting the recipient of the Washington Award which is to be presented annually to an engineer who has contributed preëminent service in promoting the public good.

ROLL OF HONOR

AT the October 12 meeting of the Council it was voted that a list of all the members of the Society now in active service be published and distributed at the Annual Meeting. This list will be prepared from the Honor Rolls published in THE JOURNAL from May to December inclusive, with such other names as may be sent in in time. The Publication Committee requests information regarding any members who have joined the armed forces of the country but whose names have not been listed as yet in the Roll of Honor. Such information if forwarded to the Secretary by November 30 will be included in the Annual Meeting pamphlet.

We have published in THE JOURNAL notices of 601 members from all parts of the Union who have notified us of their enlistment. A large proportion of members listed are commissioned in the Engineer Officers' Reserve Corps or in the Ordnance Department, Officers' Reserve Corps. The Aviation Section of the Signal Corps, and the Naval Reserve, are also well represented.

The following Roll of Honor supplements those already published, and also includes the Providence Engineering Society.

ALDEN, JOHN L., Second Lieutenant, Ordnance Department, N. A.

ALLEN, WALTER C., Major, Signal Corps, American Expeditionary Forces, France.

ARMSTRONG, HENRY C., Captain, Ordnance Department, United States Reserve.

BOARDMAN, ALBERT J., Captain, Division American Ordnance Base Depot in France, Washington.

BOYD, F. F., Lieutenant, United States Naval Reserve Force.

CLARK, W. CHAS. M., Lieutenant, Naval Service, United States Navy Yard, Philadelphia.

CRAWFORD, C. H., Captain, 302nd Engineers, Camp Upton, Yaphank.

DIEMER, MAJOR, Ordnance Department, United States Reserve.

DOLL, WILLIAM E., 35th Engineers, Camp Grant, Rockford, Ill.

FELL, SHELBY G., First Lieutenant, Sanitary Corps, Port of Embarkation, Newport News, Va.
FOX, RUDOLPH H., First Lieutenant, Ordnance Department, Officers' Reserve Corps.

GUNBY, F. M., Major, Quartermaster's Corps, United States Reserve.

HARRIS, GEORGE E., Reserve Officers' Training Camp, Fort Niagara, N. Y.
HARTWELL, ARTHUR E., First Lieutenant, Engineer Sub-Depot, Camp Wheeler, Ga.

KELLY, WILLIAM, Reserve Officers' Training Camp, Fortress Monroe, Va.
KESSLER, A. G., Lieutenant, N. N. V., Navy Department, Bureau of Ordnance.
KESSLER, HERBERT J., First Lieutenant, Ordnance Department, Officers' Reserve Corps.
KNEASS, STRICKLAND, JR., Sergeant, 332nd Infantry, Camp Sherman, Chillicothe, Ohio.

LANEY, THOMAS G., Second Lieutenant, Battalion E., 341st Field Artillery, Camp Funston, Kan.
LEA, EDWARD S., Major, Frankford Arsenal.

MCGLONE, R. G., Captain, 23rd Engineers, Camp Meade, Md.
MARSHALL, WILLIAM C., Captain, Ordnance Department, U. S. R.
MISCH, ARTHUR A., Lieutenant, Ordnance Department, United States Reserve.

OGDEN, NELSON, Gun Division, Ordnance Department, Washington, D. C.

PARISH, WILLIAM F., Signal Corps, Equipment Division, Specification Department, Washington, D. C.
PALKS, BURRITT A., Captain, Engineer Officers' Reserve Corps.
PATTON, THOMAS A., First Lieutenant, Ordnance Department, United States Reserve.

ROBINSON, PARKER M., First Lieutenant, Ordnance Department, Frankford Arsenal.
ROGERS, JOHN D., Captain, Railway Engineers.
ROGERS, THEO. B., Second Lieutenant, Engineer Officers' Reserve Corps, 114th Engineers, Camp Beauregard, Alexandria, La.
ROOT, VIRGIL A., Captain, Ordnance Department, United States Reserve.

SWIFT, HARLEY L., First Lieutenant, Engineer Officers' Reserve Corps, 16th Engineers (Railway), American Expeditionary Forces, France.

WEBER, JOHN, Lieutenant, General Engineer Depot, U. S. A.
WELLING, LINDSAY H., Ordnance Detachment, Rock Island Arsenal, Ill.

YODER, THOMAS M., Captain, Ordnance Department, N. A., Watervliet Arsenal, N. Y.

Providence Engineering Society

The following members of the Providence Engineering Society, affiliated with our Society, are engaged in active military or naval service:

MAJOR FRANKLIN E. EUGECOMB, United States Coast Artillery Corps.
MAJOR JOHN T. KEENAN, United States Reserve Engineers' Corps.
MAJOR FRANK B. GILBRETH, United States Reserve Engineers' Corps.
MAJOR CYRIL L. D. WELLS, United States Coast Artillery Corps.
LIEUT. LUCIAN MINOR, United States Navy.
LIEUT. EDWIN C. BLISS, United States Naval Reserve Force.
CAPT. NORMAN D. MACLEOD, 103d Regiment Field Artillery.
CAPT. LEIGHTON T. BOHL, United States Reserve, National Army.
CAPT. N. V. S. MUMFORD, United States Reserve, Ordnance Department.
FIRST LIEUT. FREDERICK E. COOPER, Reserve Officer, Ordnance Dept.
SECOND LIEUT. VALENTINE G. LIBBY, Reserve Officer, Engineers' Corps.
SERGT. WALLACE BURTON, 103d Regiment Field Artillery.
SERGT. C. K. APPLEBY, Coast Artillery Corps.
SERGT. EARL W. TAYLOR, Coast Artillery Corps.
RALPH S. MOHR, 103d Regiment Field Artillery.
WM. MCSWEENEY, Engineer Corps.
ANTHONY CAPUTI, Naval Reserve.
LESTER W. PRESTON, Naval Reserve.
ERNEST S. FITZ, School of Military Aeronautics.
BICKNELL HALL, JR., School of Military Aeronautics.
ROBERT N. FOOTE, School of Military Aeronautics.
HUGH BAIN, Reserve Officers' Training Camp.
HOWARD H. QUINHAM, Reserve Officers' Training Camp.
FREDERICK E. STOCKWELL, Reserve Officers' Training Camp.
JOHN V. KEILY, National Army.
RALPH NOW, National Army.

Fuel Conservation

TO THE EDITOR:

The following letter was received from Mr. H. A. Garfield of the Fuel Administration in Washington:

> DEAR PRESIDENT HOLLIS:
>
> I wish you to know how much I appreciate the offer of assistance of the Engineering Societies in connection with the campaign for the conservation of fuel.
>
> As explained to you in conversation, President Wilson has charged Mr. Hoover and me with prosecuting a campaign looking to the conservation of food and fuel. We, in turn, are looking to the experts in their several fields for assistance. Already I have conferred with the officers of the Bureau of Mines and representatives of the Council of National Defense.
>
> I venture to suggest that an effective co-operating body be organized, so constituted as to furnish to this Administration expert advice and suggestions.
>
> Very truly yours,
>
> (*Signed*) H. A. GARFIELD, *Fuel Administrator.*

This letter refers to the national campaign for the conservation and use of fuel during the war. It has great possibilities for the future, after the war is over, when we may make a more permanent organization for the saving of waste, not only in fuel, but in everything. The engineers are naturally the experts on all subjects relating to fuel and to the industries, so that they must be prepared to take their share under any Government organization.

All members of our Society are urged to assist in the nation-wide campaign for conservation of fuel. They can do this in the power stations over which they have control by teaching the employes better methods, and by careful study of possibilities of saving.

Part of the success is a campaign of publicity. We have not yet waked up to the fact that only by sacrifice and saving can we serve our country best. Every engineer of our Society, and of other Societies as well, should be prepared to speak on saving, and they should offer themselves wherever the opportunity arrives. This is one form of service that may be extremely useful.

The members of The American Society of Mechanical Engineers are well fitted by technical knowledge to speak on coal conservation, and they ought to be ready to speak in such a way that the general public can understand. In the campaign of publicity, the fuel administration will consult the Bureau of Mines, and will strive to make all leaflets and posters sent out technically correct. Any member of our Society who is not drawn into the Army, and who desires to assist in fuel conservation, would do well to write Prof. O. P. Hood, of the Bureau of Mines, Washington, volunteering to serve in some way at home, especially in teaching how to use coal and wood with economy.

It may be that in some parts of the country their services will not be needed; at the same time we all ought to be ready to do our part wherever we are. Doubtless some method will be found for organizing a speaking campaign, whether under the Bureau of Mines, through the Chambers of Commerce, or directly by the Fuel Administratioon. Professor Hood will be able to supply information on the subject, and will let our members who volunteer for speaking know definitely where to apply. This war calls for sacrifice on every one's part, and for the present we must all be prepared to volunteer our services without pay; later, methods may be found to pay engineers who give all of their time to the home campaign for saving.

Yours very truly,

IRA N. HOLLIS, *President.*

CANDIDATES FOR MEMBERSHIP

TO BE VOTED ON AFTER JANUARY 10, 1918

BELOW is the list of candidates who have filed applications for membership since the date of the last issue of THE JOURNAL. These are classified according to the grades for which their ages qualify them, and not with regard to professional qualifications, i.e., the ages of those under the first heading place them under either Member, Associate or Associate-Member, those in the next class under Associate or Associate-Member, those in the third class under Associate-Member or Junior, and those in the fourth under Junior grade only. Applications for change of grading are also posted.

The Membership Committee, and in turn the Council, urge the members to scrutinize this list with care and advise the Secretary promptly of any objections to the candidates posted. All correspondence in this regard is strictly confidential. Unless objection is made to any of the candidates by January 10, 1918, and providing satisfactory replies have been received from the required number of references, they will be balloted upon by the Council. Those elected will be notified about February 15, 1918.

The total of new applications since January 1 is 1633.

NOTE. The Council desires to impress upon applicants for membership that under the present national conditions the procedure of election of members may be slower than under normal conditions.

NEW APPLICATIONS

FOR CONSIDERATION AS MEMBER, ASSOCIATE OR ASSOCIATE-MEMBER

Colorado

RIENKS, GEORGE W., Assistant Chief Engineer,
Great Western Sugar Co., Denver

Connecticut

RYAN, E. F., Factory Superintendent,
Remington Arms U. M. C. Co., Bridgeport
TOMLINSON, WILLIAM R., 2nd Vice-President and Factory Manager, Billings & Spencer Co., Hartford
TRUAX, WILLIAM H., Employment Manager,
The Yale & Towne Mfg. Co., Stamford
WARDWELL, GEORGE W., Chief Draftsman,
Norwalk Iron Works Co., South Norwalk

District of Columbia

KLONOWER, ARTHUR A., Mechanical Engineer,
Bureau Yards & Docks, Washington

Florida

GREENE, HENRY F., Assistant Manager,
Coronet Phosphate Co., Plant City

Illinois

BACHMAN, CHARLES L., 1st Lieutenant,
U. S. Engineers Reserve Corps, Chicago
MOWRY, HARRY W., Standardization Engineer,
Western Electric Co. Inc., Chicago
PEEBLES, JAMES C., Assistant Professor,
Armour Institute of Technology, Chicago
SCHOLES, D. R., Vice-President and General Superintendent,
Illinois Malleable Iron Co., Chicago
WESTERBERG, ALFRED E., Field Manager, Appraisal Work,
Coates & Burchard Co., Chicago

Kansas

JOHNSON, CHARLES E., Engineer,
The Diamond, Osage & Ajax Gasoline Cos., Kansas City

Maine

JACKSON, LAWRENCE B., Mechanical Engineer,
The Texas Steamship Co., Bath

Massachusetts

BREKENFELD, JACOB C., Assistant Superintendent Shops,
N. Y., N. H. & H. R. R., Readville
HINCKLEY, FRANK C., State Inspector of Boilers and Examiner of Engines, The Commonwealth of Mass., Springfield
TOWNE, JOSEPH M., Vice-President,
National Blank Book Co., Holyoke
WATERHOUSE, EZRA P., Envelope Manufacturer,
Worcester Envelope Co., Worcester

Michigan

STEERE, FRANK W., Vice-President and General Manager,
Steere Engineering Co., Detroit

New York

ACHESON, EDWARD G., President,
Acheson Corp., New York
GRAY, JAMES H., Metallurgical Engineer, New York
KEMBLE, THOMAS S., Assistant Engineer,
Motor Division, Curtiss Aeroplane & Motor Corp., Buffalo
LUKE, JOHN D., Chief Draftsman and Tool Designer,
Remington Typewriter Works, Ilion
MILLER, SAMUEL W., Proprietor,
Rochester Welding Works, Rochester
RACHALS, WALTER, Assistant Chief Engineer,
United States Steel Corp., New York
SCHEIN, ALEXANDER, Assistant Chief Engineer,
The Sperry Gyroscope Co., Brooklyn
WEMYSS, DUNCAN, Superintendent Steel Factory,
Library Bureau, Ilion
ZAMBONI, LAWRENCE, Consulting Mechanical Engineer, New York

Ohio

CARROLL, EMIL J., Electrical Engineer,
American Laundry Machinery Co., Norwood
NORMAN, CARL A., Professor Machine Design,
Ohio State University, Columbus

Pennsylvania

BENNETT, WILLIAM B., Production Engineer,
Union Steel Casting Co., Pittsburgh
CANBY, W. P., Engineer of Tests,
Parkersburg Iron Co., Parkersburg
DONLEY, WILLIAM G., Engineer,
The Barrett Co., Frankford, Philadelphia
MORGAN, JAMES L., Resident Engineer,
Bayer Steam Soot Blower Co. of St. Louis, Philadelphia
PATTERSON, THOMAS S., Assistant Professor Mechanics,
Pennsylvania State College, State College

Tennessee

WATERMAN, J. S., General Manager,
William J. Oliver Mfg. Co., Knoxville

Australia

FORD, ARTHUR S., Chief Designer, Commonwealth Small Arms Factory, Lithgow, New South Wales

Canada

BERLINER, EDGAR M., Director,
Berliner Gramophone Co., Ltd., Montreal

England

POYNOR, FREDERICK W., Chief Engineer,
R. Martens & Co. Ltd., London, E. C.

FOR CONSIDERATION AS ASSOCIATE OR ASSOCIATE-MEMBER

Delaware

QUERISPEL, FRED J., Chief Draftsman,
Electric Furnace Corp., Philadelphia

New York

BISHOP, ERNEST W., Engineer,
Manual Apparatus Div., Western Electric Co. Inc., New York

Ohio

RICHARDSON, THOMAS B., Turbine Construction Foreman,
General Electric Co., Cincinnati

FOR CONSIDERATION AS ASSOCIATE-MEMBER OR JUNIOR

California

DE FREMERY, DONALD, Structural Steel Inspector,
California & Hawaiian Sugar Refining Co., San Francisco

Colorado

SELINDH, HERBERT S., Mechanical Engineer,
Holly Sugar Corp., Swink

Georgia

FLEMING, WILLIAM P., JR., Assistant Engineer,
J. S. Schofield's Sons Co., Macon

Illinois

KROEPLIN, WILLIAM A., Secretary,
Sheet Metal & Conveyor Co., Chicago

Ohio

DAWSON, MAYNARD S., Draftsman, The Woodard Machine Co., Wooster

FOR CONSIDERATION AS JUNIOR

Connecticut

CARTMELL, NATHANIEL M., Industrial Engineer's Staff,
Winchester Repeating Arms Co., New Haven
LAZARUS, GEORGE H., Department Engineer,
Remington Armory, Bridgeport
PALATINE, RENARD L., Instructor,
Continuation School, Waterbury
PORTER, RAYMOND E., Designer and Draftsman,
The Lake Torpedo Boat Co., Bridgeport

Illinois

MINKEMA, WILLIAM H., Assistant to Production Manager,
The Whitman & Barnes Mfg. Co., Chicago

Louisiana

GIACOMINO, JOSEPH L., Production Engineer,
Fylton Bag & Cotton Mills, New Orleans

Maryland

SPICER, GEORGE W., Designing Draftsman,
Bethlehem Steel Co., Sparrows Point

Massachusetts

FLEWELLING, MILTON F., JR., Chief Draftsman,
Ashton Valve Co., Cambridge
GOULD, HAROLD I., Draftsman,
Morgan Construction Co., Worcester

New York

BROWNELL, FREDERICK J., Engineer,
Western Electric Co., New York
HENNINGSON, LOUIS A., Designer and Estimator, Maintenance Department, American Locomotive Co., Schenectady
ISENBERG, MARTENS H., Erecting Engineer,
Combustion Engineering Corp., New York
MORSE, EVERETT R., 1st Lieutenant Ordnance Department,
U. S. A., Ithaca
REBER, JAMES B., Superintendent,
Columbian Rope Co., Auburn
RIXMANN, CHRISTIE, Installation Div.,
De La Vergne Machine Co., New York
SCHENKER, ABRAHAM W., Designer,
Lawrance Aero Engine Corp., New York
YOUNGBLUTH, R. O., Managing Engineer,
Architectural Dept., American Radiator Co., New York

Ohio

MILKEY, LESTER E., Field Engineer and Assistant Sales Manager,
The Sandusky Foundry & Machine Co., Sandusky

Pennsylvania

CROWLEY, HENRY L., Production Engineer, No. 4 Shop,
Bethlehem Steel Co., South Bethlehem
WIKAN, CORNEL, Designer,
Pittsburgh Steel Products Co., Monessen

APPLICATIONS FOR CHANGE OF GRADING

PROMOTION FROM ASSOCIATE MEMBER

Massachusetts

COE, HARRY L., Vice-President,
Harpham, Barnes, Stevenson & Coe, Boston

PROMOTION FROM JUNIOR

Illinois

BIGELOW, CARLE M., Chief Engineer,
Cooley & Marvin Co., Chicago

Missouri

BECK, CHARLES E., District Sales Manager,
De La Vergne Machine Co., Kansas City

New Jersey

SCHMIDT, FRANCIS W., Assistant Engineer,
American Agricultural Chemical Co., Carteret

New York

TOWNSEND, ALBERT C., Associate with M. R. Geiger, New York

Ohio

RODGERS, HORACE P., District Sales Manager,
Steam Equipment Mfg. Co., Cleveland

Rhode Island

HALL, JAMES V., Assistant Professor of Mechanical Engineering, Brown University, Providence

REINSTATEMENT AND PROMOTION FROM JUNIOR

New York

NOLLE, FRED, Chief Engineer and Manager,
Ice Machine Dept., De La Vergne Machine Co., New York

NECROLOGY

GEORGE SMITH RIDER

George S. Rider was born in Providence, R. I., on May 4, 1858. Upon leaving college he served an apprenticeship with the Brown & Sharpe Manufacturing Co. in Providence, and then spent a number of years in their shops. Later he traveled abroad extensively, and upon his return he became connected with the Warner & Swasey Co. at the time of the construction of the Lick telescope.

Mr. Rider's next position was with the Cummer Engine Co., from which he resigned to become an instructor in drawing and machine work in the University School of Cleveland, where he remained for about twelve years.

During these years at the University School Mr. Rider also carried on a private business as a consulting engineer, which in later years developed into the firm of George S. Rider & Co., consulting and designing engineers, of Cleveland, Ohio. He was the senior member of this firm up to the time of his death—a period of about fifteen years, during which time he designed many large and important power and industrial plants in that part of the country.

He was a member of The Franklin Institute of Philadelphia, the Cleveland Engineering Society, and the Cleveland Chamber of Commerce.

Mr. Rider became a member of the Society in 1900. He died on September 11, 1917.

WILLIAM THOMPSON ILER, JR.

William T. Iler, Jr., was born in New York on June 28, 1892. He was educated in the public schools of the city and was graduated from the Stuyvesant High School. In June 1915 he received his degree in mechanical engineering from New York University.

During the summer of 1913 he worked under the Heights of Buildings Commission in New York as engineering drafts-

man, and in the following summer served as rodman and assistant topographical draftsman in the Department of Public Works in New York. He obtained his shop experience in the shops of H. W. Johns-Manville & Co., Bound Brook, N. J.

WILLIAM T. ILER, JR.

Later he became assistant juinor engineer with Gunn, Richards & Co. in Utica, N. Y. At the time of his death he was holding the position of assistant manager of the Slocum, Avram & Slocum Laboratories, N. Y.

He became a Junior of the Society in 1916. He died on October 18, 1917.

GEORGE E. SCARFE

George E. Scarfe was born in London, England, in November, 1886. He received his education in the London grammar schools, and when still very young started to learn his trade by becoming a machinist's helper.

His bent was toward electrical science, and in 1890 he accepted a position as engineer with an electric lighting company in New York. He resigned in 1892 to become associated with the Western Electric Co., in whose employ he was sent to San Miguel, San Salvador, Central America, as assistant engineer of construction on an electric-light plant there. Subsequently Mr. Scarfe held the positions of chief engineer of the Towanda Electric Lighting Co., and construction engineer of the Warren Manufacturing Co., Sandusky, Ohio.

In 1900 he became associated with the Pacific Gas and Electric Co. in its Nevada division in charge of the power plant, and in 1904 became manager of the South Yuba Water Co. Mr. Scarfe's ability was evidenced not only in the immediate work of the company, but as a consulting engineer for the large gold-mining companies of that region.

After several years' connection with the Pacific Gas and Electric Co., Mr. Scarfe was appointed to the office of district superintendent, which position he held till April, 1916, resigning to enter the private practice of electric and mechanical engineering, when he acted as consulting engineer for the Pacific Gas and Electric Co., Empire Mines Co., Pittsburgh Mines, South Eureka Mines, and a number of others.

He was an associate member of the American Institute of Electrical Engineers. He became a member of the Society in 1916. He died at his home in Nevada City on August 24, 1917.

SVERRE TRUMPY

Sverre Trumpy was born in Bergen, Norway, in January 1882. He was educated in a German preparatory school and received the degree of B.M.E. in 1903 from the Royal Technical University, Berlin.

During his college course, from 1899 to 1903, he served his apprenticeship with the Accumulatoren Fabrik Aktiengesellschaft, Hagen, Westphalia. Upon graduation he accepted the position of assistant superintendent of the municipal electric plant, Bergen, Norway. His next position was with the Fort Wayne Electric Works of the General Electric Co., Madison, Wis., as machinist. In 1904 he became associated with the Gisholt Machine Co. in Madison as draftsman, and in 1906 was made chief draftsman of the vertical boring-mill department. In 1911 he was placed in charge of the engineering department and the drafting room.

Mr. Trumpy became a member of the Society in 1913. He died at his home in Madison, October 17, 1917.

THOMAS C. WALKER

Thomas C. Walker was born in England in 1859. He was educated in the public schools there, and it was there also that he served his apprenticeship in machine work and tool making. He gained his shop experience with the Birmingham Small Arms Co.

For four years he was in charge of the machinery for the Carbon Mill in Colorado. He was also associated for about four years with the Denver & Rio Grande Railroad Co. At the time of his death he was president of the Walker Manufacturing Co., Denver, Col.

GEORGE E. SCARFE

He became a member of the Society in 1891. He died on February 13, 1917.

AMONG THE SECTIONS

FOUR signal events this year will go down in the history of the Sections as marked developments in this activity. The first is the new By-Laws which were approved at the Council meeting in October and published in the November issue of THE JOURNAL. The second is the Sections Session to be held at the forthcoming Annual Meeting. The third is the development of the first State Section—Connecticut—with five Branches, at Bridgeport, Hartford, Meriden, New Haven and Waterbury. The fourth innovation is the holding of meetings of the Committee on Sections in the various cities where Sections are established; such meetings have recently been held with marked success at St. Louis, Milwaukee, Chicago and Detroit.

The Sections Session, which will be held on Thursday morning of the convention, represents the first time that the Session of a general meeting has been given over to the discussion of Sections' matters. This Session will be in charge of the Committee on Sections and Mr. D. Robert Yarnall will preside. Three-minute talks will be given by delegates from each of the Sections, followed by general discussion.

The Committee on Meetings and the Committee on Sections decided to hold this Session to discuss ways and means of increasing the coöperation and cohesion of the Section elements at this period of the Sections' development. There are many vital topics to be considered and it is hoped that the discussion will be fruitful and will guide this activity of the Society into the way of accomplishing big things, not only for the engineering profession but for the public at large.

The phases of the Sections' work are manifold. In each center in which Sections are established, opportunities for service arise at every turn. The new Sections' By-Laws govern the activities of each Section only to the extent of ensuring that its procedure is in conformity with the Constitution of the Society; they leave the Section free to carry out the details of its coöperative work with other societies' sections and with the local organizations and the public.

In addition to the talks they will give at the Sections' Session, the delegates will come into personal contact with the Council and with the management of the Society at the convention, and will thus have opportunity for familiarizing themselves particularly with the parent Society's attitude towards its branch organizations. This is an important essential, for the individual Section members should understand clearly in just what relation they stand to the parent Society, and by such understanding they will be able to derive the greatest benefit for themselves and to perform the most good for their fellow Section members and for the membership of the Society at large.

Other Section activities at the Annual Meeting will include "experience meetings" held by delegates, in which each delegate will outline what his Section has accomplished during the year; the Sections' Luncheon, which will be held this year at the Engineers' Club, 32 West 40th Street, New York, on Tuesday, December 4, at 12:30 p.m., and the usual informal meetings of Sections' delegates with the Committee on Sections.

THE PRESIDENT'S TRIP

IN the following letter to Mr. Rice, Dr. Hollis conveys the impressions of his recent trip to the Pacific Coast Sections. The President was very much struck by the spirit of self-sacrifice he found everywhere among the engineers—everyone wanting to serve his country.

MY DEAR MR. RICE:

I left Washington on the evening of October 15 and had dinner in St. Louis on the following evening with the Executive Committee of our society in that center.

Then I went to El Paso, arriving on the afternoon of October 18, and made an address to the Southwestern Society of Engineers during the evening, on the subject of The Engineer and the War. There were present all of the members who could get to El Paso, and a general audience of citizens. On the nineteenth the entire membership made an inspection of the engineers' camp on the Rio Grande, not far from El Paso, and in the evening there was a dinner.

I arrived in Los Angeles in the very early morning of the twenty-first and there made two addresses. The first was before the engineers of Southern California, and about 250 were present, representing all of the engineering societies; the subject was again The Engineer and the War. At Throop Institute I addressed the entire body of students. This institute is in Pasadena and will become the same kind of institution that the Rensselaer Polytechnic Institute at Troy is.

I reached San Francisco on the evening of the twenty-fourth and met the engineers representing all societies at dinner on the following evening. About 250 were present, and the subject was The Moral Influence of Engineering Efficiency. On the twenty-sixth I visited the University of California, but did not meet the students as I went there to see the instruction in aviation. On the twenty-eighth I met a number of the members of our society in Portland, Ore., and had dinner with them.

On the evening of the twenty-ninth I had dinner in Seattle with all of the societies represented in that city. There were something under 100 present.

On the thirty-first I left for home on the Canadian Pacific and arrived on Monday, November 5.

The strong impression I received from this trip was the spirit of self-sacrifice amongst the engineers, every one of whom wants to serve the country in some capacity. In Southern California and Arizona alone 250 engineers have already gone into the Engineer Corps of the Army, and there was not a single discordant note in connection with the requests for opportunities to serve.

The only symptom that was at all disturbing to an American citizen was the evident lack of information on the meaning of this war. While all were willing to serve, a great many seemed slow to understand the sacrifice that this great struggle is going to demand of all of us.

Another thing that impressed me was the value to the engineering societies of more frequent communication with the West. I believe the four engineering societies ought to unite to provide just such visits as this every year to ensure the Coast being kept in complete touch with what we all want to do.

(*Signed*) IRA N. HOLLIS.

On his way out to the Coast Dr. Hollis attended a conference at the U. S. Chamber of Commerce, at Washington, on the coal question, and offered the services of the Engineering Council in connection with the campaign for the conservation of fuel. During this conference he, Professor Breckenridge and Mr. Lieb were added to the Chamber of Commerce Committee on Fuel.

SECTIONS' COMMITTEE VISIT

Committee on Sections at St. Louis, Milwaukee, Chicago and Detroit, October 22 to 25

THE members of the Committee on Sections feel that a great deal was accomplished by their recent trip to four of the Sections located in the Middle West, and the opinions which have been expressed by the officers of the respective Sections visited are indicative of their appreciation of the recognition shown them.

The following members of the Sections Committee made the trip: D. Robert Yarnall, *Chairman*, L. C. Marburg, Prof. Walter Rautenstrauch, Dean Charles Russ Richards. Ernest Hartford, Secretary to the Sections Committee, accompanied the party. The only member of the Committee unable to be present was Major E. H. Whitlock, whose work for the Government made it impossible for him to obtain a leave of absence.

The party arrived at St. Louis on October 22 and was met at the station by the Executive Committee of the St. Louis Section. A visit was made to the Ashley Street Power Station of the Union Electric Light and Power Co., where the operations involving the change from the old reciprocating units to the new 20,000 kw. turbines were demonstrated to the party.

The St. Louis members turned out to the number of over sixty to the supper which was followed by a paper on the developments at the Ashley Street Power Station, presented by Mr. John Hunter, Vice-President-elect. Then the visitors each spoke outlining their work in the interest of the Sections, the manner in which Sections may coöperate in making THE JOURNAL the leading publication of its kind and suggestions for coöperation between Sections and the vital work of the Research Committee.

On the following day the Committee reached Milwaukee. visited the plant of the Allis-Chalmers Company, and later had supper and discussed section matters with members of the Milwaukee Section. At this meeting a movement was started to develop the membership and scope of the Milwaukee Engineering Society with which the A.S.M.E. Section is affiliated.

The Chicago Section was next visited and a supper meeting held at the Hotel La Salle, at which were present about twenty-five of the active members of the Chicago Section. At this meeting plans were laid in the direction of securing close coöperation of the A.S.M.E. Section with the Western Society of Engineers, the Chicago Engineers' Club and the other engineering organizations of the city.

On the fourth successive day the Committee were guests of a Section, this time the A.S.M.E. organization in Detroit. The local committee met the visitors at the train and conducted them during the day to a number of plants where a more intimate acquaintance was obtained with the local conditions and the individual leaders in the engineering profession in Detroit. In the evening a dinner was held at the Chamber of Commerce, about sixty being present. Professor Rautenstrauch presented a paper on the Relation of the Engineer to Finance, and Dean Richards told of the research work being carried on at the Experiment Station of the University of Illinois. The meeting voted unanimously to invite the Society to hold its 1919 Spring Meeting at Detroit. All the week's activities were productive of much that should materially enhance the value of membership to those located not only in the four Sections visited, but to the entire Society.

D. ROBERT YARNALL,
Chairman, Committee on Sections.

CONNECTICUT SECTION INITIAL MEETING

THE first meeting held under the auspices of the new Connecticut Section was held at New Haven on November 14. There were two sessions, both devoted to the subject of fuel conservation. The first began at 2.30 p. m. at Lampson Lyceum, Yale University, with Mr. Henry B. Sargent in the chair. Over 150 were in attendance.

At the outset of the meeting, Mr. Sargent outlined the development which led to the formation of the Connecticut Section with its five branches at Bridgeport, Hartford, Meriden, New Haven and Waterbury.

Prof. L. P. Breckenridge presented the first paper on The Problem of Coal Conservation. He outlined the necessity of coal for heat, light and power, and by means of a series of lantern slides gave some very interesting data relative to the production of coal throughout the world, and also, in more detail, the production in the several states of this country. The distribution of coal by rail and water were shown generally to be the determining factors in the choice of coal used. Charts showed the percentage of coal used (*a*) by states; (*b*) by industries, commerce, in homes and for making steam; (*c*) per capita for several states, and (*d*) in relation to manufactured products.

The latest available data on coal production and consumption is for the years 1914 and 1915. In 1914 of the 1,800,000,000 tons produced throughout the world, about 600,000,000 came from the United States. Great Britain ranked second and Germany third. About one-sixth of the coal produced in the United States is anthracite, but the statistics show that since 1880 the production of hard coal has never reached 100,000,000 tons. During the same period the production of bituminous coal has advanced from 50,000,000 to probably over 600,000,000 tons this year. The conclusion drawn by the speaker was that we would have to learn to burn bituminous coal in our homes.

The total production of coal in the United States from 1906 to 1915 was 4,918,717,285 tons. Of this, Pennsylvania produced all of the anthracite and a large portion of the bituminous. West Virginia, Illinois, Ohio, Kentucky and Indiana ranked next in the order given in the production of bituminous coal. In 1915, Pennsylvania used more anthracite than any other state, New York ranking next, the New England States third. Three million tons were exported.

The railroads used 122,000,000 tons of bituminous coal in 1915, and the use by states was, Pennsylvania most, and, in their order, Illinois, Ohio, the New England States, and New York. New York is the only state which used more anthracite than bituminous.

The use of coal per capita in the Pacific States is 0.35 tons;

in New York, New Jersey and Pennsylvania, 6.52 tons; in Ohio, Indiana, Illinois and Michigan, 5.31 tons; and in the New England States, 4.85 tons.

Professor Breckenridge's paper was discussed by Professors Seward, Perry, and Barker, Messrs. R. J. S. Pigott and A. J. German. Mr. T. W. Russell, fuel administrator for Connecticut, also participated.

The following suggestion to save fuel in Connecticut was made by Professor Breckenridge and adopted by vote of the meeting:

VOTED, That the Connecticut Section of the A.S.M.E. instruct the chairmen of its several branches to name a committee on fuel saving for their respective localities.

After a series of motion pictures, dinner was served at the Yale Dining Club, at six o'clock.

EVENING SESSION

The evening session was held at Mason Laboratory, Sheffield Scientific School, with Mr. J. Arnold Norcross in the chair.

Mr. O. P. Hood, mechanical engineer of the Bureau of Mines, Washington, D. C., described briefly the scope of the Bureau's work, but his paper generally covered the subject of Fuel Conservation by the Bureau of Mines.

Mr. Hood said that under normal conditions the Government buys over $8,000,000 worth of coal annually. The Bureau has been making war on waste for years and has tried to get people to believe what they knew to be so. The Bureau has believed that educational methods were, in the long run, the sane methods by which to accomplish fuel conservation, but under the present conditions it is necessary that power also be used to compel saving—and at the same time the educational campaign must be speeded up and carried on on a magnitude never before attempted. In view of the fact that only about 20 per cent of the coal mined is used for domestic purposes, whereas 63 per cent is used in the production of power, it is through those persons engaged in the latter occupation that the greatest saving can be most easily secured.

The 20 per cent used for domestic purposes is handled by about 20,000,000 persons and the possible saving would be about 10 per cent, so that it would be an expensive proposition to attempt to reach this enormous group to effect a net saving of 2 per cent of the coal mined. On the other hand, the 63 per cent used for power purposes passes over the shovels of not over a quarter of a million firemen, so that it is in this direction the first drive for conservation should be made. Fuel economy is an art and must be taught to the man at the furnace.

The coal recently mined has shown by analysis from 14 to 15 per cent ash, as against about 8 per cent normally, showing that the increased production of coal is really an increase in ash. One of the prominent central-station operators recently stated that this additional ash has cost his plant an additional 20 per cent to secure the same production. This faulty condition likewise increases the number of coal cars that are required to transport this additional ash.

In its experiments the Bureau has developed that it is feasible to burn soft coal for heating purposes and obtain practically the same results as are secured by the use of hard coal.

Mr. Hood pointed out that investigation in the conservation of fuel soon unearths the many fallacies that are in circulation. The engineers have the correct technical data at hand to further consistent conservation of fuel, and the Bureau of Mines is coöperating with the engineering societies and other organizations in order to give such organizations the benefit of its service in having facts correctly stated before they are disseminated.

Mr. Hood suggested that considerable data of value were contained in the Bureau of Mines technical papers Nos. 80, 97, 137. He also called attention to a pamphlet about to be issued of interest to designers of boilers. This is being prepared by Henry Kreisinger, Mem.Am.Soc.M.E.

The paper was discussed by Prof. E. H. Lockwood, Mr. Bromley, associate editor of *Power*; Mr. F. O. Wells, and Professor Breckenridge.

The meeting closed with a very inspiring address by President Ira N. Hollis on the part the engineer is destined to play in the service to mankind in the twentieth century. The audience was much impressed by the stirring words of Dr. Hollis.

SECTIONS REPORTS

BALTIMORE

November 7. The first meeting of the season was held at the Engineers' Club and the following discussions were presented: Evaporators, by William L. DeBaufre, Mem.Am.Soc.M.E., mechanical engineer, U. S. Naval Engineering Experiment Station, and Considerations in Municipal Ownership, by Prof. A. G. Christie, Mem.Am.Soc.M.E., Johns Hopkins University.

With the aid of lantern slides, Mr. DeBaufre first described simple evaporators and multiple-effect evaporators. He said that experiments at the Naval Experiment Station had demonstrated that increased efficiency could be secured by reducing the amount of tube surface in former standard types of evaporators, and that the rate of heat transfer had been thereby increased from 250 B.t.u. per sq. ft. per degree difference in temperature per hour to a new rate of 900 to 1000 B.t.u. Methods of handling had also been developed which obviated the necessity of frequent cleaning to remove scale.

Mr. DeBaufre next showed a new form of evaporator he had developed and with which the efficiency of a triple effect could be obtained in a single effect. In this new evaporator a portion of the vapor leaving the evaporator at low pressure is carried to a nozzle-type ejector which receives live steam through a nozzle. The low-pressure vapor is caught up by the high-velocity steam from the nozzle and forced into a diffuser tube in which it is compressed to the higher pressure, then led back into the evaporator jackets where its latent heat is available for further evaporation. Tests were presented by the speaker showing the efficiency of the apparatus, and diagrams were also shown which illustrated graphically where the gains occurred.

In the discussion that followed, one of the speakers pointed out that this system with its high efficiency should prove of value to power-plant engineers in view of the increasing tendency toward using distilled water for boiler feed.

Professor Christie compared experiences in municipal ownership of public utilities of cities in Canada and in the United States and outlined the conditions that have tended to make the Canadian experiences successful and the American ventures generally failures. Emphasis was laid on the need of absolute separation of the utility from politics and of placing its control under a single trained executive, preferably an engineer. The financial problems of municipal ownership were outlined and discussed. The final conclusion was that political conditions at present existing in the United States did not appear to be favorable to the adoption of municipal control of utilities. Private ownership under close supervision of public utility commissions seemed to be the best solution of the problem.

A. G. CHRISTIE,
Section Secretary.

BUFFALO

October 17. Scientific Research was the subject of a discussion by Dr. C. E. K. Mees, director of the research laboratory of the Eastman Kodak Co., at a meeting of the society.

Dr. Mees said that the Germans who have accomplished so much in the way of scientific research are not geniuses but simply hard-working men who accomplish much because they are numerically large and have fine laboratory organizations. He considered that great scientific discoveries are simply a matter of ability, hard work and luck, and that it is just as possible to speed up research work as other kinds. The more men at work and the better the organization of the laboratory, the more work will be accomplished. Today is the day of standards, classifications, grades, brands and comparative analytical tests, he said, and tomorrow will bring, with its still higher standards and more exacting tests, synonyms for tremendously accelerated competition.

Dr. Mees illustrated his talk with stereoptican views of modern laboratory methods and equipment.

The Automotive Section of the Engineering Society of Buffalo held a very interesting meeting on October 24, at which Mr. Otto M. Burkhardt, mathematical research engineer of the Pierce-Arrow Motor Car Co., read a paper on Crankshaft Design. Discussion followed, in which David Fergusson and Ernest Harris, of the Pierce Company, and Forest E. Cardullo and Charles M. Manley of the Curtiss Company took part. In the course of his discussion Mr. Burkhardt drew the following striking parallel:

"Three groups of scientists are remarkably interested in one and the same problem, *i.e.*, the problem of balancing.

The economist is seeking—The balance of trade.

The statesman is eagerly watching—The balance of power.

And last but not least, the engineer is developing balanced crankshafts.

(1) If balance weights are attached to a 3 or 4-bearing 6-throw crankshaft, its running at high speed should improve remarkably because considerable centrifugal forces and subsequent transverse deflections are eliminated

(2) It is an easy matter to attach weights to a 7-bearing 6-throw crankshaft. This will not improve its running because there is practically no transverse deflection that could be eliminated, and the main bearings are less favorably loaded

(3) A 3 or 4-bearing 6-throw crankshaft if properly balanced will not be much lighter (if at all) than a 7-bearing shaft

(4) In the case of a 3 and a 4-bearing crankshaft, an intense torque occurs in the crankpin, a phenomenon which does not pertain to the 7-bearing type of crankshaft

The subject proved very timely and interesting and the meeting was well attended.

LOUIS J. FOLEY,
Assistant to Section Secretary.

CONNECTICUT

November 14.—The first meeting held under the auspices of the new Connecticut Section was held in New Haven on November 14. A full account of this meeting appears on page 1022.

HENRY B. SARGENT,
State Section Chairman.

CINCINNATI

October 18. The Research Laboratory Applied to Industry was the subject of an address by F. O. Clements at an interesting meeting of the Section. The speaker described how for some years a group of manufacturers of Dayton have been looking forward to the building of a number of factories surrounding a research laboratory that would be common to all of these factories. While some of the factories were being erected, war was declared and the purposes for which these factories were to be used were changed. One of the factories was turned over to the Dayton-Wright Airplane Co., although it had originally been intended for another purpose. The research laboratory had been intended for the study of problems connected with industry, and its purposes were somewhat modified by the declaration of war. However, its general organization had been pretty carefully thought out, and a laboratory was organized about six months ago. It contains a group of enthusiastic young chemists and engineers, carefully selected. The speaker mentioned some of the problems that had come up for solution and the progress made toward their solution. Naturally, many of the problems that are being studied are of a secret nature, and cannot be mentioned, but the possibilities of such a research laboratory were discussed at some length. The speaker paid a tribute to the general spirit of coöperation which prevails in the city of Dayton and which made such a research laboratory possible.

JOHN T. FAIG,
Section Secretary.

ERIE

November 13. The Engineers Society of Northwestern Pennsylvania and the Local Section of the Society held a joint meeting at the Erie Public Library, under the auspices of the Local Section of the Am.Soc.M.E. An illustrated lecture was delivered by H. G. Barnhurst, chief engineer of the Fuller Engineering Co., Allentown, Pa., on Pulverized Coal and Its Future. The subject proved to be of considerable interest, as the present high cost of petroleum has boosted the price of fuel oil to a point that makes discussion of available substitutes of interest to all engineers. Mr. Barnhurst is unusually qualified to speak on this subject, as he has been closely following the matter for some years, and has supervised the installation of a number of large plants.

M. W. SHERWOOD,
Section Vice-Chairman.

NEW YORK

November 13. The November meeting of the Section was preceded by a buffet luncheon at which over 80 were present. The Acquaintanceship Committee took special pains to welcome new members and the occasion was made very enjoyable for all present.

Mr. Maxwell W. Upson presented the paper of the evening on "Concrete Piling." Mr. Upson spoke at the outset on some of the problems involved in overcoming the difficulties met with in supplying special equipment of this character. He then gave a detailed, illustrated description of the Raymond concrete pile, a new development which has never been used to any commercial extent before. This pile is a composite pile, the lower part being of wood and the upper of concrete. The special advantage of this pile construction is that it overcomes two of the problems always inherent to the composite pile. The first is to secure a satisfactory joint between the concrete and the wood, and the other is to maintain alignment between the two parts.

The speaker also touched on the advantage of this kind of pile due to the ease of transportation of the wooden part. At this time it is impossible to transport long wooden piles from one section of the country to another.

HERMAN GREUL,
Section Committee Member.

PHILADELPHIA

October 16. A most important and successful meeting was held by the Philadelphia Section in conjunction with the Engineers' Club at Witherspoon Hall. Homer L. Ferguson, president and manager of The Newport News Shipbuilding & Dry Dock Co., presented the timely and interesting subject of The War's Effect on Merchant Shipbuilding. Mr. Ferguson outlined the effect of the submarine menace, and called attention to the necessity for action on the part of the United States Government. He pointed out the difficulties involved in building ships due to the scarcity of labor, and particularly to the scarcity of that kind necessary in the shipbuilding trades. The war would be won, he said, if America would only provide sufficient shipping facilities to properly transport and supply our armies on the other side. A number of new shipbuilding concerns have sprung up to meet the great demand and he expressed it as his belief that many of the leaders in these enterprises do not appreciate the tremendous difficulties involved in this line of work. The high-handed action of some of the labor unions in limiting the number of apprentices and production at this time he considered greatly to be regretted.

JOHN P. MUDD,
Section Secretary.

PROVIDENCE

November 9. Several meetings of note have been held during the past month, among which might be mentioned that of the

Efficiency Section at which Chester T. Morey, assistant superintendent of the Rhode Island Tool Company, read a paper on the Handling and Moving of Material. He discussed the question of incoming and outgoing material and its arrangement, control and transportation within the shop.

On Tuesday evening, November 13, a paper was read on Some Steels used in Machine Construction, by Chester B. Sadler, of the Rhode Island Tool Company. Mr. Sadler touched on the composition, physical properties, heat treatment and metallography of these steels.

The regular November meeting of the Providence Engineering Society was held on Tuesday evening, November 20, Chester T. Lucas, associate editor of *Machinery*, being the speaker of the evening. Mr. Lucas showed a moving picture film of the Machining of a 9.2-in. High-Explosive Shell furnished by *Machinery* and gave a talk on the manufacture of artillery ammunition.

JAMES A. HALL,
Correspondent.

SAN FRANCISCO

October 25. The activities of this Section so far have been confined to the dinner tendered to President Hollis on the occasion of his recent visit to the Coast. This meeting took the form of a joint meeting of the local branches of the national engineering societies, each of the societies being represented by a speaker.

Prof. Harris J. Ryan, of Leland Stanford Jr. University, spoke on behalf of the American Institute of Electrical Engineers. Prof. C. D. Marks, of Stanford University, represented the American Society of Civil Engineers. Prof. Andrew C. Lawson, of the University of California, spoke for the American Institute of Mining Engineers, and Dr. L. H. Duschak, of the U. S. Bureau of Mines, represented the American Chemical Society. Prof. B. F. Raber, chairman of the San Francisco Section, presided at the meeting, and the guest of honor was introduced by Geo. W. Dickie, Vice-Pres.Am.Soc.M.E., with whom Dr. Hollis had been associated at the time he was naval inspector at the Union Iron Works, San Francisco.

The general subject discussed during the evening was the relation of engineering to the war, each speaker taking up the particular branch of engineering represented by his society.

The event of the evening was a stirring address by President Hollis on the subject of The Moral Influence of Engineering and Efficiency.

C. H. DELANY,
Section Secretary.

ST. LOUIS

October 16. The visit of Dr. Ira N. Hollis, president Am.Soc. M. E., was made the occasion of a dinner reception at the Missouri Athletic Club. Owing to the fact that the president's stay in St. Louis was limited to a few hours, it was impossible to arrange a meeting of the Section, but the time was spent in talking over the affairs of the Society with the executive committee.

The members of the executive committee were greatly impressed with the fact that Dr. Hollis's policy throughout the year has been first and foremost one of service to the engineering profession. Surely there could be no more effective results obtained by the president of such an organization as ours than the adherence to the idea that everyone in the organization is to do his part toward being of some real service to his fellow engineers.

October 22. On this evening, at the American Hotel Annex, the St. Louis Section held a joint meeting with the National Committee on Sections. The meeting was preceded by a dinner, at which were seated seventy-five members of the Section and guests. Mr. R. L. Radcliffe, chairman of the Local Section, introduced Mr. D. Robert Yarnall, chairman of the National Committee on Sections, asking him to preside during the meeting. Very interesting and helpful talks were made by the different members of the visiting committee, whose ideas with reference to the management and activities of the Local Section were received with a great deal of interest and will prove of great value.

Mr. John Hunter, Mem.Am.Soc.M.E., chief engineer of power plants of the Union Electric & Power Co., delivered an illustrated lecture upon the subject The Development and Operation of a Large Power Station. Mr. Hunter took the Ashley Street Plant of his company as illustrative of his lecture, and showed during the course of the evening seventy stereopticon views of the growth and development of this great station. The audience of technical men was deeply interested in what Mr. Hunter had to say, and the explicit manner in which he demonstrated his subject.

The chairman of the Committee on Sections congratulated the Local Section on the nomination of Mr. Hunter to vice-presidency in the Society.

E. H. TENNEY,
Section Secretary.

STUDENT BRANCHES

Student Branch Conference

As has been the custom for the past few years there will be a Conference of Student Branch representatives held during the Annual Meeting. Each of the forty-five Branches is invited to send a delegate to attend this Conference, which will take place on the afternoon of Wednesday, December 5, at four-thirty o'clock.

This Month's Reports

BUCKNELL UNIVERSITY

November 5. L. W. Sipley gave an interesting talk on Steam Turbines. Prof. Frank E. Burpee, Mem.Am.Soc.M.E., expressed his regret that the usual custom of the University's tours of inspection of the different plants would probably not be carried out this year as many of the plants have been closed to visitors.

H. R. PARS,
Branch Secretary.

CARNEGIE INSTITUTE OF TECHNOLOGY

November 7. There was a large attendance at this regular meeting, at which it was announced that practically every junior and senior student in mechanical engineering had joined the Society this year. Following the regular business session a talk on central-power-station operation was given by Mr. J. C. Hobbs, Mem.Am.Soc.M.E.

Mr. Hobbs first spoke on modern automatic stoking and described in detail the very efficient devices at the Detroit Edison Co. for burning all the combustible material in the refuse. These devices consist of grinders which carry out the refuse and prevent clinkers from being formed. He laid special stress on the construction of firebrick walls to take care of unequal expansion on opposite sides.

Mr. Hobbs gave a brief description of turbines, stating that the best practice in starting turbines, also in opening steam valves into large pipes, is to open with a shock, then cut off again almost immediately and come on gradually. This is to prevent the steam from floating in on top in a cloud, and causing unequal expansion to the top and bottom of the turbine casing and the pipes.

The speaker did not think that dry pipes on boilers were practical; in fact he said he had obtained better results by removing the dry pipes from the boilers. He also gave some ideas on determining the most efficient piping.

The talk was followed by a general discussion, and after a short social session, during which smokes and refreshments were served, the meeting adjourned.

G. R. BRANDIN,
Branch Secretary.

UNIVERSITY OF MISSOURI

The officers elected at the November 8 meeting of the Branch were: Honorary Chairman, H. Wade Hibbard, Chairman, L. N.

Thompson, Corresponding Secretary, J. W. Baldwin, Secretary-Treasurer, K. K. King. *Governing Committee*: H. Wade Hibbard, L. N. Thompson, J. R. Wharton, William Copper, M. M. Slaughter.

The meeting was addressed by the Honorary Chairman on the subject of the National Society and the relations to it and the advantages of membership in a student branch; also by Prof. J. R. Wharton, Mem.Am.Soc.M.E., upon his summer work in the valuation of a motor-engine factory about to be taken over by the Government. At a later meeting the Honorary Chairman is to give an address upon his work this summer for the War Department in Washington, D. C., as an organization, management and production engineer, in the laying out of organization and efficiency plans for expanding departments expending $274,000,000, according to present appropriations.

The School of Engineering is engaged in a thoroughly patriotic service in infusing into the students an intensity of purpose in preparing for their later engineering work in the Army or munitions plants; to this the students are heartily responding. The Honorary Chairman never knew of such enthusiastic and intense study as is now being given to the various courses. The men almost feel that they are in uniforms and serving their country. Forty-seven members of the University faculty are in uniform and drilling three times a week under Captain Craigie of the U. S. Army, a course specifically authorized by Act of Congress in a university where the Government has authorized a Reserve Officers Training Corps. Six hundred students are in the Corps also. The Faculty Company will shortly be in target practice on the rifle range, will be taken out among the hills for map plotting, and next summer will go into camp in the Ozark Mountains, under Captain Craigie. The quota of the University in Columbia and Boone County was made for the Liberty Loan, the faculty alone subscribing about $50,000. The faculty and students are giving $10,000 for the Army Y. M. C. A. in the $35,000,000 campaign.

H. WADE HIBBARD,
Honorary Chairman.

NEW YORK UNIVERSITY

November 4. Ernest Hartford, Secretary to the Committee on Student Branches, addressed the members at the first meeting of the Branch for the season. He explained the privileges of the student-members, the benefits to be derived from the Society and also announced the meetings that the Am.Soc.M.E. is to hold and the topics to be discussed. Professor Houghton made a few suggestions concerning the organization of this Branch.

It was decided to hold one big meeting each month on the third Friday of the month, at the Engineering Societies Building at 8:00 p. m. Prominent men in the engineering world will head the program of each meeting, with addresses and illustrated lectures. It was announced that the first meeting would be held November 23, and everybody would be welcome.

FREDERICK GROEPLER,
Branch Secretary.

POLYTECHNIC INSTITUTE OF BROOKLYN

November 6. The first meeting of the Branch for the season resulted in the election of Charles L. Schweizer as chairman, to replace Frederick Bromm, who has been called into service, and William Sumner as vice-chairman. The regular business was followed by a lecture on Atoms, Electrons and the Constitution of Matter, delivered by Dr. A. A. Adler, Mem.Am.Soc.M.E. Interesting topics of Dr. Adler's talk were the size of the electron, the composition of X-rays and the heat waves of the sun.

NATHAN N. WOLPORT,
Branch Secretary.

RENNSELAER POLYTECHNIC INSTITUTE

November 7. The third regular meeting of the Branch was held on this date at 7:45 p. m.

Mr. J. M. Dewey spoke upon the present plans for equipping the army with field laundry machinery. He thoroughly explained the problems met with in designing this machinery for motor-truck units, train units, and base units, and the methods pursued in overcoming each of these problems.

Mr. G. H. Carragan described the manufacture of paper. His talk was in the nature of a supplement to the recent trip the Branch made through the plant of the West Virginia Pulp and Paper Co., at Mechanicville, N. Y. He gave the history of the development of the industry, a summation of the various kinds of fibers used in paper making and a review of the different grades of paper and the processes followed in making each grade.

R. A. MARRIOTT,
Branch Secretary.

EMPLOYMENT BULLETIN

THE SECRETARY considers it a special obligation and pleasant duty to make the office of the Society the medium for assisting members to secure positions, by putting them in touch with special opportunities for which their training and experience qualify them, and for helping anyone desiring engineering services. The Society acts only as a clearing house in these matters.

IN forwarding applications, stamps should be enclosed for transmittal to advertisers; applications of non-members should be accompanied by a letter of reference or introduction from a member, such reference letter to be filed with the Society.

GOVERNMENT POSITIONS

The Society has been asked to make suggestions of men for the following positions with the Government. Non-members possessing the necessary qualifications may avail themselves of these notices by enclosing with their reply a personal introduction to the Secretary.

SEVERAL ENGINEERS who have had considerable experience in the design of machines and machine tools, which would enable them to comprehend quickly questions involved in the designs of field-artillery material. 2426.

THE MOTOR SECTION of the Ordnance Department is charged with the procurement of tractors and trucks for hauling artillery and ammunition, including maintenance, inspection and training of drivers, also similar work in connection with armored cars and armored tanks. The principal duties of this section, however, will be the maintenance and upkeep of these vehicles in the field. 2427.

A NUMBER OF MEN with milling, mechanical or electrical engineering training and experience, at salaries ranging from $1440 to $1800 per annum, for investigating grain-dust explosions and fires in grain mills and elevators throughout the various parts of the United States. Traveling expenses and sustenance will be provided. 2428.

CIVILIAN POSITIONS

SEVERAL INSTRUCTORS in mechanical engineering are needed by one of the large state universities in Middle West; men having specialized training and experience in machine design, gas-power engineering and general laboratory work. Give complete statement of training, experience, minimum salary expected, and recent photograph. 1045.

DRAFTSMAN with at least five years' experience in the detail of machine parts. Permanent position. State age, experience, salary expected, and references. Location near New York City. 2012.

YOUNG MAN not over 35 and not subject to military draft. Must possess some technical training or experience in mechanical lines including drafting. Energetic man with executive ability required. Salary to start, $1300 to $1500. Location New York. 2166.

PHYSICISTS, ENGINEERS, DESIGNERS AND DRAFTSMEN for work of research development and design related to problems of telephonic, telegraphic and radio communication, which are matters of public importance. Opportunities for such men in both temporary and permanent positions. Apply by letter. Location: New York. 2178.

DESIGNERS, DETAILERS and TRACERS for chemical plant. Location Philadelphia. 2370.

MEN with mechanical engineering training, in connection with the various operating and test problems in operation of a large power plant. (*a*) Two junior engineers who have had experience in test work on various types of power apparatus to start at $100 per month. (*b*) For the shift-operating jobs three vacancies, starting with salary of $150 per month. Numerous opportunities for promotion; men who make good always considered for transfers to various other plants. Location Virginia. 2371.

ENGINEERS to train and develop in the fundamentals of a New York firm primarily engaged in the distillation of coal tar with the resultant principal production of bituminous road and roofing materials, with the ultimate object of filling operating positions in various plants as foreman, head chemist, assistant superintendents, or superintendents. Preferably, but not essentially, men of chemical-engineering training. As contemplated work will eventually be of an executive nature; ability to handle men is a desirable asset. 2374.

DESIGN DRAFTSMEN on plant layout. Not necessarily technical graduate. Salary $30 to $35. Location New York. 2383.

THREE TECHNICAL GRADUATES for steam engineering and general testing. Work covers steel mills in Pennsylvania, Ohio, West Virginia and Indiana. 2384.

YOUNG MAN with experience as engineer or draftsman to assist in sales department. Apply, stating salary expected. Location Pennsylvania. 2386.

HIGH-GRADE DESIGNING DRAFTSMEN on jigs, fixtures and gages, preferably men experienced in this line. Apply by letter stating experience and salary expected. Location New York. 2388.

PRACTICAL STEAM AND FUEL ENGINEER who also has a technical education. 2389.

ASSISTANT ENGINEER to take general charge of engineering work, including bearing application and shop engineering. Send full particulars in reference to past experience, age, and salary expected. Location Ohio. 2390.

PRODUCTION MANAGER, experienced in factory management, to take charge of factory. Prefer graduate mechanical engineer, and if possible a designer of automatic machinery. Man with executive ability and organizing ability, training in modern efficiency methods and factory management who is systematic, thorough and able to plan methods for getting work through the factory and has demonstrated ability to increase production. Factory makes small articles requiring precision machinery and employs 500 to 600 people. Location New York State. 2391.

MAN capable of taking charge of department employing about 100 men. Must thoroughly understand the bleaching, dyeing, sizing and calendering of cotton goods, a good handler of men; should command respect and obedience. Position would pay about $35 per week to start and more after the man was able to demonstrate his ability. Location Staten Island. 2394.

EXPERIENCED MAN capable of aiding in organizing and following up the introduction of a production department along modern lines, at a large factory located in the East. Must possess initiative and originality and be able to handle successfully shop problems. Man who has had experience in hardware or small tool lines preferred. State experience, age, reference and approximate salary required. 2395.

PLANNING DEPARTMENT AND TIME-STUDY MEN. A well-established firm can offer exceptional opportunities for effective and interesting work to engineering graduates who have had substantial experience with modern industrial methods, with special reference to time study, the determination of standard tasks, and planning and scheduling production. In reply state age, education, experience, present and expected salary. Location Massachusetts. 2396.

MACHINE-DESIGNING DRAFTSMAN. Technical graduate with some years' practical experience in a shop and at least 4 or 5 years in drawing room designing as well as making drawings. Desire man who can follow up work in shop and inspect machinery, a special line of stapling machinery for use in box making being manufactured to contract. Salary about $150 to $200 per month, according to qualifications. Location Illinois. 2399.

FACTORY MANAGER to assume complete charge of large firebrick plant. Must be between 28 and 36 years of age, forceful, possessed of technical as well as practical knowledge and able to prove former success in large undertakings. Location Missouri. 2402.

DRAFTSMAN acquainted with smelting work for position in El Paso, Tex. 2404.

VALUATION ENGINEER for important eastern railroad, to take charge of rolling-equipment valuation work. Should have special experience in valuation, cost and depreciation of car and locomotive equipment. Salary $3600 or more, dependent upon qualifications. 2406.

DRAFTSMEN of general mechanical experience. Men of integrity, reliability and industry wanted, with experience in general drafting, design and layout work. State age, details of experience, salary expected and references. Location Delaware. 2407.

DRAFTSMAN with sufficient experience to enable him to lay out machinery in new plants, including the making of drawings covering electric-light and power systems. Permanent position in engineering department. Prefer man with chemical-plant experience, or who has done drafting for consulting engineer. State fully qualifications and past experience. Applicant must be in possession of technical training. Salary $1200 to start. Location southern Ohio. 2409.

PRESS-ROOM FOREMEN. A Connecticut firm over a century old needs young blood in positions of responsibility. Must have knowledge of and be in sympathy with scientific-management methods. Fair salary and a bonus to start. State age, experience in detail, salary expected and present position, also when you could report for duty. 2410.

ASSISTANT SUPERINTENDENT to become superintending mechanical engineer for electric and finishing plant; should have shop experience and be accustomed to handling men. Some knowledge of chemistry and heat processes preferred. Salary to start $200 a month. Location Niagara Falls. 2412.

BOILER MAN fully conversant with every detail of design and construction of steam boilers, particularly water-tube boilers. Must be willing to make an investment in a progressive boiler shop. Location New Jersey. 2413.

NEW YORK CONCERN desiring to extend sales force for tool steels, want men of good address and shop training to educate for the work of salesmen and steel experts. Men between the ages of 25 and 35. Salary depends upon man. 2414.

MECHANICAL DRAFTSMAN for position in Omaha. Car and locomotive work. Application can be made through New York office. 2415.

POWER-PLANT MEN experienced in industrial lines, design and construction of steel and power plants. Location New York City. 2418.

POWER SUPERINTENDENT to take charge of a power plant near New York City, consisting of 2600 b.hp. of stoker-fired B. & W. boilers burning anthracite, 2500 b.hp. of B. & W. wasteheat boilers, and 15 prime movers—steam turbines and Corliss engines—up to 1500 I.hp. driving d.c. generators and air compressors. 2420.

SALESMAN familiar with time- and cost-keeping methods. Salary and commission basis. Headquarters New York. 2421.

DRAFTSMEN AND FIELD MAN. Young man with knowledge of anthracite-colliery practice. Location Pennsylvania. 2422.

YOUNG MEN with technical training in M. E. course to enter employ of company manufacturing flow meters. Rapid advancement to engineering work in power plants or sales. Location Massachusetts. 2423.

SAFETY INSPECTOR. Man with mechanical training, capable of making intelligent suggestions to engineering department for the provision of all necessary safeguards to comply with the requirements of the law and to make a plant as nearly mechanically safe as possible. Should be well qualified with educational methods to be employed in accident-reduction work. Position will pay $2000 a year. Location New England. 2424.

SALESMAN wanted for an old established firm. Must be cleancut, energetic salesman, not an order taker. Must have thorough knowledge and acquaintance with the automobile trade. While a certain amount of mechanical knowledge is not absolutely essential, such will

receive first consideration. This "ad" is to attract the attention of high-grade men only, who are capable of conducting a branch office. Answer fully, giving past experience, salary expected and state when can report for duty. Location Middle West. 2428.

TWO FIRST-CLASS ELECTRICAL DRAFTSMEN, preferably with powerhouse experience. Location New York. 2429.

MECHANICAL ENGINEER with wide experience in all kinds of handling and conveying equipment and solution of labor-saving problems, to supervise such work for a company having a number of large manufacturing plants in different parts of the country. Good opportunity for the right man. State age, education, experience and salary desired. Location Middle West. 2430-A.

MECHANICAL ENGINEER having practical experience, particularly in handling and conveying equipment, to study labor-saving problems in a large industrial plant and make recommendations. Good opportunity for the right man. State age, qualifications and salary desired. Location Middle West. 2430-B.

SALES ENGINEERS for hand stoker. Will pay liberal commission on the gross sales price, advance a drawing account of $150 per month. Man should have a technical foundation and be familiar with combustion problems. Would expect a man to spend two weeks with organization to gather selling data, facts and operation of the stoker, thoroughly equipping him for work. Location New England. 2431.

TOOL DESIGNERS AND DRAFTSMAN, particularly those who have had experience on small interchangeable parts. Paying the highest wages obtainable in return for first-class men of engineering ability, also paying a 12½ per cent bonus quarterly, or at the end of full bonus periods, to all employees based on wages earned and for faithful and continuous service. Location New England. 2432.

METALLURGIST, RESEARCH AND EXPERIMENTAL ENGINEER in a New England factory machining and grinding small parts from alloy steel. Man with technical training preferred. 2436.

MAN TO TAKE CHARGE OF SPECIAL CLASS in steam engine practice. The course will consist of one hour a week in the class room and one night of two hours in the engine laboratory. Class will not deal with the students of the regular engineering course, but with the men who are connected in some way with steam engine work, and who wish to obtain a knowledge of the practical and scientific principles underlying the operation of different types of steam engines. Location: New York. 2437.

YOUNG ENGINEER to take up safety work in connection with plant and to take general charge of the building inspection. Location: New England. 2438A.

CHIEF CHEMIST in connection with investigation work involved in the manufacture of product. 2438B.

ASSISTANT MECHANICAL ENGINEER in large manufacturing plant. Young man with experience on pumping machinery preferred. Location New Jersey. 2439.

MEN AVAILABLE

MECHANICAL ENGINEER, EXECUTIVE. Technical education. Two years' commercial experience. Six years as designer on steam turbines and power plants. Five years as works manager of metal-working plant. Desires position as works engineer or assistant to executive in manufacturing or engineering firm. Excellent health and habits. Thirty-one years old, with family. L-392.

FACTORY EXECUTIVE, MASTER MECHANIC OR PLANT SUPERINTENDENT. Age 39, 18 years' experience as production superintendent in the manufacture of engines, condensers, high-vacuum air pumps, centrifugal pumps, etc. General engineering work, both medium and heavy. Has traveled extensively in connection with field work. Good executive, of pleasing personality, alert and resourceful, exercising well-balanced judgment in all dealings and retaining confidence of organization. L-393.

BUILDING-EQUIPMENT ENGINEER seeks connection with a manufacturing or construction concern requiring the services of an executive with broad experience in the design, purchase, construction and maintenance of power plants, heating, ventilating, lighting, refrigerating, kitchen and laundry systems. Has also been very successful in the planning of floors, offices, departments, etc. Services available after December 1. L-394.

MECHANICAL ENGINEER. Technical graduate, age 25, with steam-engineering and anti-friction-bearing experience, desires position in engineering or engineering sales. Salary $1500 per anum. L-395.

MECHANICAL ENGINEER. Techical graduate, age 38, with 14 years' experience in industrial work as draftsman and engineer, in the manufacture of soap and illuminating gas, and in coal mining and plant construction. At present chief draftsman for a chemical plant. Desires position as chief draftsman or mechanical engineer. Salary $2500 to $3000. Location preferred, East. L-396.

MECHANICAL SUPERINTENDENT. Age 40, broad experience in design, construction, maintenance and operation of machinery, power and industrial plants. Salary $4800. L-397.

EXECUTIVE. M. E. education, age 39, married. Several years' experience in handling men in field, shop and office. Experienced in construction and operation of large lumber-manufacturing plants. Department and territorial manager for large corporation manufacturing and selling mechanical lines. Executive with company contracting for, designing and installing coal-preparation plants. Will consider opportunity in foreign or domestic field. L-398.

CHIEF DRAFTSMAN OR ASSISTANT CHIEF ENGINEER. Mechanically trained, age 29, married. Over four years' practical experience in design and manufacture of jigs, fixtures, gages and tools. Capable of handling men. At present in charge of a vital department of large munition-manufacturing concern. Foreign positions considered. L-399.

GRADUATE MECHANICAL ENGINEER of leading technical school desires position of executive nature in connection with building heavy machinery or plant-construction work. Six years' practical experience covering shop work, designing and business. At present engaged in specialty of engine design. L-400.

COMBUSTION AND STEAM ENGINEER. Associate-member, age 29, married. Technical graduate, over six years' experience along lines of power-plant tests and efficiency work. Extended experience with competitive, acceptance and efficiency tests of power-plant equipment, turbines, engines, condensers and auxiliaries, stokers, soot blowers, brick, feedwater regulators, gages, meters, etc. At present employed. Location New York City or vicinity preferred. Salary $2250. L-401.

PLANT ENGINEER. Graduate mechanical engineer with 13 years' experience in the design, erection and operation of power plants and manufacturing machinery. Specialist in the operation of power plants and the repairs and maintenance of machinery. Well trained in the use of electricity as applied to machinery. Most familiar with the equipment found at coal-mining properties. L-402.

MECHANICAL AND ELECTRICAL ENGINEER. Technical graduate, age 35, married. Good executive, with 11 years' experience. Engaged in public-utility work embracing construction, operation and maintenance. Specialist in power generation and distribution. Salary $3600. L-403.

MECHANICAL AND ELECTRICAL ENGINEER. Technical graduate, age 28, with manufacturing experience on gas producers, internal-combustion engines, pumps, compressors, electrical motors, generators, and measuring instruments. General knowledge of power plants, storage batteries, and electrical distribution. At present chief of bureau of gas and electricity in large city. L-404.

PURCHASING ENGINEER of greatest varied experience will change for responsible connection, in charge of active and large organization paying commensurate salary. L-405.

EXECUTIVE MANAGER. An executive of ability and aggressiveness, a mechanical, technical graduate, at present employed, desires to connect with a manufacturer whose business may need systematizing and building up as to organization and production. Has had a varied experience in different branches of manufacturing, operating industrial plants along lines of scientific management, and is fully conversant with modern methods of manufacturing and marketing product. Only interested in a permanent position offering good possibilities for improvement. L-406.

At the Massachusetts Institute of Technology the faculty changes have introduced some new problems since there has been so much demand by the U. S. Government and by industrial corporations related to the war for men of technical skill. So great has been this draft that in the department of electrical engineering one-third of the staff has been called away, in mechanical engineering a dozen men have gone into war work while civil engineering, chemistry, naval architecture and the other departments have sustained serious losses.

ENGINEERING SURVEY

A Review of Engineering Progress and Attainment in Mechanical Engineering and Related Fields, Including a Digest of Current Technical Periodicals and a Selected List of Engineering Articles

British Railways and the War

A PAMPHLET published in London by F. A. McKenzie tells of the part played by British railways in the war.

Before the war the British and German railway organizations presented a striking contrast. The German railways were almost wholly state-owned, and many of them built primarily for purposes not of commerce but of strategy. Railway administration was most closely allied to that of the German Great General Staff. Even the cars were built to a size that could be employed for transporting the maximum number of men, or, in the case of freight cars, gun carriages and war materials.

The British railways, on the other hand, were privately owned and built solely for commercial purposes. It was the business of the railways to provide for the needs of the communities they served and obtain a fair return for their shareholders and nothing else.

There was only one thing done in the way of militarization of transports. In 1871, after the Franco-Prussian war, the British government was empowered by act of Parliament to acquire by royal proclamation any or all of the railways of the United Kingdom in time of war. There were in existence two organizations to deal with this situation. One, a committee of railway managers, first known as the War Railway Council and afterward as the Railway Executive Committee, was to act as a central organization and to coördinate the activities of the different railways in war time. Working in coöperation with it was the Engineer and Railway Staff Corps, a volunteer organization of railway workers, whose purpose was to develop schemes, methods, and personnel for the war railway service. It was composed of general managers of leading railways, prominent contractors, engineers and other railroad men.

Both of these organizations worked in conjunction with the Director-General of Military Transports, and by 1912 complete plans of operation were worked out. In fact, every railroad manager had in his safe a confidential, sealed, unopened document detailing a scheme of mobilization. In it he was told exactly what to do; the trains to be moved; their starting points and destinations, and the entire schedule of running if war came.

On August 4, 1914, the day that war was declared, the railways of England, Wales and Scotland, but not Ireland, were taken over by the government. The terms of compensation to the railroads were not announced at that time, and the lines remained the property of the companies.

At first the sole purpose was to facilitate the movements of troops as the war developed, but as economy became more and more essential the scope of the Railway Executive Committee became extended until now it is in supreme command.

A feat of which British railroad men are quite proud was the transportation of the expeditionary force, numbering 120,000 men, with a vast amount of material of war to Southampton for embarkation for France, simultaneously with the mobilization of the territorials and without essentially disturbing the usual traffic.

Altogether, at Southampton, for example, for practically every day of the first three weeks of war the London and Southwestern Railway handled during a period of 14 hours no fewer than 73 military trains, including the running of them to the boat side and the unloading of the full equipment and ammunition and horses. The trains arrived at intervals, averaging 12 minutes, and practically every train, without exception, came in on schedule time.

To American railroad men it will be of interest to hear that this rapid transportation of the troops to Southampton is recognized by the British railroad men themselves as having been possible only because the docks there had been carefully planned by the railway company for the handling of large masses of men and quantities of material. The trains conveying the troops and freight were run right down to one of the berthing stations; they were emptied there with the greatest expedition and were then sent back. Each train had a prominently placed index number on it by which it was known throughout its trip; its exact time and departure at each place was scheduled and the schedule had to be kept.

One of the noteworthy features of this rapid concentration of troops was that the ordinary traffic of the railways was maintained with comparatively little alteration. Here and there a section of the line was closed for a few hours, particularly sections of some of the junction lines across London, but the general public scarcely realized what was happening.

The conclusion of the final agreement between the government and the companies automatically brought about a great economy in some departments, especially the accounting department and the departments dealing with solicitation of business.

One of the problems which confronted the railroads at the beginning of the war was the demand for higher wages by the men. After the government took over the railroads several agreements were made, culminating in the terms of settlement of November 13, 1915, by which the National Union of Railway Men and the Associated Society of Locomotive Engineers and Firemen undertook not to present to the railway companies any fresh demands for increased bonuses or wages.

The rise of the cost of living proved, however, a stronger factor than formal agreements and several additional war bonuses have since been granted to the men. In justification of these increases in wages it was pointed out that the wages in other industries increased in the meantime. The railway men under the war labor regulations could not leave their employment for other work and it was felt that they could not reasonably be expected to continue work under far lower wages than other men in allied industries in the same districts.

One of the outstanding features of war operation of British railroads is the extensive employment of female labor. Up to the beginning of the war British railways had been very reluctant to employ women even for office positions, but the shortage of men and the desire to release as many as possible for service with the colors caused the introduction of women workers early in 1915.

The pooling system introduced by the government led to

numerous and extensive economies, such as, for example, the establishment of the common use of open freight cars, called common-user arrangement. A minor economy was an agreement by the railways to accept each other's "paid" and "to pay" stamps and labels on parcel traffic. This saved much labor and led to a further development in January 1917, when the Railway Executive Committee announced that from a given date the cartage charges for all descriptions of traffic must be paid by the sender at the forwarding station. The whole system of bills and accounts for passenger-goods traffic was thus swept away.

The saving in printing was so extensive that at least one large company was able to sell many tons of paper which had been stored for office use and put this on the market at a time when paper was scarcest.

On July 4, 1917, the Controller of Coal Mines published a system for the purpose of reorganizing the transporting of coal by railways for inland consumption. Under this system England, Wales and Scotland were divided into twenty areas and each area had to take its supplies from certain fixed districts of production. It was estimated that the plan would effect a saving in railway transport of not less than 700 million ton-miles annually. The scheme was based on four main issues:

1 That consumption of coal should take place as near the producing point as possible

2 That in view of the superior facilities offered by the main traffic lines the movement of traffic should follow these routes wherever possible

3 That the movement of coal should, as far as possible, be in well-defined directions—north to south, north to southeast, north to southwest, and east to west

4 That an area producing less coal than sufficed for its own need should not send any portion of its output to other areas. That an area producing more coal than it required for consumption within the area itself should only distribute to adjacent or convenient areas

This scheme did not affect water-borne coal, anthracite, or coke of any description, but was the precursor of other schemes which were to reduce unnecessary traffic in goods to the minimum.

No description of the work of the British railways in the war would be complete without some reference to the service in handling the wounded to which exceptional attention has been paid and for which special trains have been built. In fact, all the great English railway works devoted their utmost skill and care to the ambulance trains, endeavoring to provide the best accommodations for the transportation of the wounded.

The change in the system of management of the British railways, while effected primarily to meet the extraordinary war conditions, was so far-reaching and profound that responsible British railroad men recognize already that the problems in railway management and control raised by the war will not entirely come to an end with the conclusion of peace. A new era has begun in railway management and it will be impossible to go back completely to pre-war conditions. But even if it were possible, it would be undesirable. The British railroad operators have learned a good deal. Coöperation has proved to be better than cut-throat competition.

There are other problems such as the wages of the men after the war and the future of women's labor on the railways, but it is expected that changed conditions after the war may provide in themselves a solution for all these possible problems. British railroads hope that having solved the problems of war traffic and employment in unequal fashion they will master the lesser problems of the coming peace.

Notes from the Engineering Colleges

Throop College of Technology

According to information received from Walter H. Adams of the Department of Mechanical Engineering, comparatively little research work is carried on in mechanical engineering due to lack of time on the part of the instructors. There is being carried out, however, the installation of a wind tunnel housed in a new building to carry on aeronautical research work. This research work will be in charge of Dr. Harry Bateman, who will devote his time mainly to research and will do very little teaching.

With regard to the general laboratory equipment a new building was added last summer, which has doubled the laboratory space available for mechanical-engineering laboratory purposes. A motor-car engine, a 25-hp. air compressor and a 25-hp. heavy-oil engine are in this laboratory, and, in addition to other minor equipment, go to make a very well-equipped laboratory for mechanical-engineering work. Further, the equipment available includes a small engine and a small turbine direct-connected to an electrical generator, with the necessary boiler equipment, condensers, etc.

In the testing laboratory there is a 150,000-lb. Olsen testing machine which was on exhibition at the Panama-Pacific International Exposition. In addition, there is a 30,000-lb. Riehlé tension and compression machine, cement-testing and briquetting equipment, torsion machines, etc.

In the hydraulic laboratory they have a Pelton water wheel, water turbine, single- and multi-stage centrifugal pumps, piston pumps and minor equipment.

The following statement is quoted from Mr. Adams's letter:

"Our laboratory is willing to undertake any preparedness work which it is possible to do with the staff and apparatus available. Over one-third of the students who have entered the Army and Navy have come from the mechanical-engineering course in spite of the fact that we are offering six courses at the College. Last year Throop College was designated as one of the branches of the Reserve Officers' Training Corps, thus initiating work in military training at the College. So far, Throop College of Technology is the only Engineer Unit of the Reserve Officers' Training Corps in the country. This year our professor of military science and tactics will be Captain Charles T. Leeds, Corps of Engineers, U. S. Army, Retired. Captain Leeds is a graduate of West Point and the Massachusetts Institute of Technology, so that it is expected to develop a strong course in military engineering here at the College. We have formed no special units such as ambulance or aviation corps, as our men have gone into all branches of the service."

The first locomotive for American war-service railroads in France was completed in 20 working days, and engines of this type are now being turned out at the rate of about 30 per day. About 680 of these locomotives and over 9000 standard-gage freight cars are on order. The locomotive weighs about 166,400 lb., with the tender about 275,000 lb.—*Official Bulletin.*

U. S. BUREAU OF STANDARDS

THE Bureau of Standards, as shown by the following report of its activities, is continuing its active work both on war problems and problems of what may be called peace activities. A significant feature of these activities is the close and growing collaboration between the Bureau and the industries. Thus, as seen from the present report, the Bureau is preparing material for the use of manufacturers of glass pots, and even making pots in its own plant which will enable American manufacturers to produce the more difficult types of glass.

Graphite crucibles experimentally made by the Bureau have been shipped to various foundries for purposes of tests under actual shop conditions.

At the same time work of great practical interest is being carried on in lines requiring a high degree of preliminary scientific training for its prosecution. Thus, the Bureau's study of dicyanin stained glass has yielded unexpectedly satisfactory results, and long infra-red radiations have been successfully photographed. In fact, an invisible spectral region as large as the entire visible spectrum has been thus made accessible to photographic methods in ultra-red. Ten or twenty years ago this would have been justly spoken of as an epoch-making achievement in experimental research, but in the last decade the world has grown so accustomed to great achievement that it is difficult to attract more than its passing attention. This does not, however, detract from the value of work done.

Safety Belts for Aviators

The Bureau of Standards has prepared specifications for leather to be used in the construction of safety belts for aviators.

Lubricants

The Bureau has been engaged on the development of specifications for airplane-motor oil in coöperation with those interested in this problem, including representatives of refining companies. The Bureau has an aero-mechanical engineer engaged in developing and describing an oil suitable for airplane motors. This expert is also working with the sub-committee on lubricants of the International Aircraft Standardization Board.

Optical Glass

The work on special clay pots for making optical glass is progressing rapidly. Pots as large as 28 in. in diameter have been made from porcelain mixtures. Lining of very good mixtures have also been applied to clay pots. In this connection the Bureau is preparing material for the use of manufacturers, as porcelain lining for the glass pots now being made commercially. A large plaster mold has been completed at the Bureau to be used in "casting" pots, and sufficient material has been prepared for "casting" a 28-in. pot in the near future. The use of pots purchased in the open market seems to preclude the possibility of making the more difficult glasses. The Bureau, therefore, is making pots in its own plant, and the work is progressing very rapidly. It is believed that when these are ready, satisfactory glass of all kinds can be made. During the past month two melts of light flint glass, one of a dense flint glass, three of a light crown glass, and three of boro-silicate glass have been successfully completed by members of the staff of the Bureau.

Graphite-Crucible Development

Twenty-six finished experimental crucibles have been completed for service testing in actual practice. These have been shipped to various foundries for this purpose. They are made in sizes used in industrial practice.

Stucco and Plaster

In the investigation of the durability of stucco and plasters, two small test buildings just erected on the Bureau of Standards' grounds have been coated with special stucco in order to study the weathering effects on this type of stucco, and with the special type of construction used. These form a valuable addition to the test structures already erected for this purpose.

Building Stones of the United States

In the investigation of building stones available in this country for structural purposes, 30 different specimens were submitted to laboratory test and examination. These included the determination of specific gravity, or absorption, and of the compression and transverse strength. A freezing and thawing machine is being erected for this work. This will simulate actual weathering conditions, and will be used to determine the life of various types of stones under various weather conditions.

Ultra-Violet Radiation from Quartz Mercury-Vapor Lamps

The increasing importance of quartz mercury-vapor lamps makes it very important that the methods for measuring total radiation and ultra-violet radiation be carefully studied. The Bureau is reducing these measurements of routine operations. In the final standardization of such lamps, the Bureau will be in a position to specify the intensity of the invisible ultra-violet radiation in absolute units. Such certification will be analogous to the rating of ordinary electric lamps in terms of candlepower.

Infra-Red Photography

The Bureau's study of dicyanin stained plates has yielded unexpectedly satisfactory results. Infra-red radiation of waves longer than 11,000 Angstron units (1.1 microns) have been successfully photographed, using the iron arc and cobalt as light sources for this purpose. An invisible spectral region as large as the entire visible spectrum is thus made accessible to photographic methods in infra-red. The work was deemed of such importance that maps of the solar spectrum were prepared, covering the region from 6800 Angstron to 9600 Angstron units. The work has been in active operation during the past month.

Exposure Tests of Steel Sheets

A visit was made to Pittsburgh and Annapolis to inspect the steel sheets exposed by the American Society for Testing

Materials. At Pittsburgh there is undoubted evidence that the coppered sheets are resisting corrosion better than the uncoppered material. The less severe conditions at Annapolis have not brought out this point. It is learned that at Ft. Sheridan the test has not advanced far enough to justify drawing any conclusion.

News of Other Societies

Southwestern Society of Engineers

The annual convention of the Southwestern Society of Engineers was held at El Paso, Texas, October 18 to 20 inclusive.

The guest and speaker of the Convention was Dr. Ira N. Hollis, President of The American Society of Mechanical Engineers and of the Worcester Polytechnic Institute. His principal address, The Engineer in the Present War, emphasized that men, not inventions, will win the war, the keynote being struck in his words: "The blood of our children, the youth of America, only will solve this war. After all, it is not an engineer's war—it's a war of industrial organization."

Dr. Hollis again addressed the convention at the luncheon at the Ninth Engineers' Camp, Major O'Connor commanding. At this time he lauded the work of the United States destroyers in the war zone, stating they were far superior to anything in the British or German Navies. He again spoke to the society at the annual dinner that closed the formal session, the keynote of this address being that "America is a country of united people," quoting, "We have something now in the country the world has never seen before—three thousand miles of people with the same thoughts and the same ideals."

The opening address, "The Engineering School and the War," by President Barnes, emphasized the lack of research and executive type of engineers, and the belief that the war will teach the schools the need of developing their courses to train men along these lines.

The most enjoyable morning was spent with the Ninth Engineers' Camp, Major O'Connor commanding, and the Eighth Engineers' Camp, Major Peterson commanding, at which sessions Pontoon Bridge Building, Field Surveying, Fortification Work, and Trench Building were thoroughly demonstrated. These sessions, bringing the membership in close touch with Army Engineering, were especially enjoyable and beneficial. The stories of the troubles of cantonment construction as were found at Camp Codie, Deming, N. M., was carefully explained by C. A. Tilton, an auditor of contractor, and Major C. H. Miller, Engineer-in-Charge. The success of the construction of this cantonment against possibly the greatest odds at any of the camps speaks well for American engineering ability, and proves that the American engineer can construct successfully even if the resources at hand are meager.

The address of Dean G. M. Butler, of the University of Arizona, upon Some Effects of the Draft Law on the Arizona Mining Industry, very clearly brought out the problems that the Arizona mining companies have been facing during this great period of stress.

Nominations of officers for the coming year were made as follows: President, Dean G. M. Butler, University of Arizona; First Vice-President, Dean S. H. Worrell, Texas State School of Mines; Secretary, C. E. Barglebaugh; Treasurer, R. W. Goddard. For Directors to serve three years, Messrs. W. E. Robertson and Gerald Sherman, the following officers holding over as Directors: Messrs. Barnes, Gillis, Gladding and Andros.

At the present time the membership of the Society is 119, and it is interesting to know that practically 20 per cent of the membership is now in war service. This, and industrial conditions in Arizona, brought about a smaller attendance than usual, but the enthusiasm and interest in the meetings made up in a large measure for the shortage.

Gas as Gasoline Substitute

The advantages and disadvantages of gas as a substitute for gasoline in motor traction are discussed in a report just issued in England by the executive committee of the British Commercial Gas Association, which says, in part:

"When gas is used on a mobile vehicle several limiting conditions present themselves, inasmuch as the gas for driving the engine must be carried by the vehicle itself. The question of storage, therefore, arises first.

"From information that has appeared in the technical press, the use of gas for motor traction has been successfully worked out by Messrs. Barton Bros., of Beeston. Their arrangement consists of a flexible balloon-like holder carried on the roof of the vehicle. The holders are made of woven fabric treated so as to be impervious to gas and to withstand the effects of weather. They are made in various sizes from 150 to 500 cu. ft. capacity. The gas is therefore stored under a very slight pressure, probably only a few tenths of an inch head (water gage) above atmosphere, and this pressure is steadily maintained as the holder exhausts itself in feeding the engine. So far as the engine is concerned the low pressure of the gas in the flexible holder is of no consequence. The gas flows into the engine just as the air does; that is by the inductive power due to the operation of the engine itself."

The results of an experimental test made by the committee are thus described:

"A car having been equipped with gas reservoirs, it was driven round a district with about the average kind of road and variations of level, and the observations made indicate a radius of action 25 miles per 1000 cu. ft. The average speed was nine miles per hour, including the stopping and slowing down which was several times necessary at crossings, etc., but which is, of course, consistent with everyday conditions.

"Results obtained at Coventry show that the brake power developed by a petrol motor when driven by gas is about 85 per cent of the power developed by petrol, and that this proportion is fairly constant over a wide range of speeds; also for equal brake power on test bench one gallon of petrol appears to be equivalent to 250 cu. ft. of gas.

"Our own observations derived from general running of a vehicle on petrol and gas point to a ratio less favorable to gas, namely, that one gallon of petrol is equivalent to 300 cu. ft. of gas.

"Much, however, of course, depends upon the quality of the gas and the kind of petrol used, there being several qualities of both procurable at the present time.

"Regarding the equivalents of gas and petrol, the gas supplies in different parts of the country are, like electric supplies, not standardized either as to price or quality, and it will be found that the gas obtained at some places will give a better mileage than gas obtained in another place. The gas equivalent is, however, unlikely ever to be higher than 300 cu. ft. per gallon of petrol but may be as low as and even lower than 250 cu. ft. These figures, together with local prices for gas and petrol, will enable those interested to

calculate the relative costs of running." (*Journal of Commerce*, October 16, 1917, p. 9)

Industrial Reconstruction

An important manifesto on industrial reconstruction which has just been issued bears the signatures of more than forty well-known business men and university professors, and of a still larger number of officers of trade associations. The manifesto has also the support of the editors of some seventy trade and technical journals. The scheme outlined in the manifesto is put forward as the practical outcome of all the authoritative suggestions that have been made during the last three years for the organization of British industries and the development of trade and commerce.

Concerning the needs of industrial reconstruction the signatories say that to meet the urgent needs of the times it will be necessary to increase considerably our efforts to develop British industries on the following lines:

1 The mobilization of each industry for common action
2 A greater degree of coöperation between manufacturers
3 Coöperation between labor and capital and the avoidance of industrial strife
4 A more complete association between scientific institutions and traders
5 Education better adapted to our commercial needs
6 Each industry to be studied as a whole, and freed from unnecessary internal competition
7 Every trade to present a united front to foreign competition
8 Output regarded as a duty by both capital and labor
9 Encouragement by the Government of the activities of traders, with a minimum of interference.

It is contended that the matter cannot be left to chance, and that some national scheme is necessary which shall insure the securing of these objects.

Finally the manifesto puts forward under six headings a scheme for industrial reconstruction. It is suggested that the basis of the scheme should be a vocational franchise, which would make possible the organization of each trade separately under a trade council composed of capital and labor, and the decentralization of a large proportion of national work now attempted by Government departments. The Government, it is proposed, should establish a department to promote or encourage trade, and the first function of this department should be to create representative trade councils in every trade. It should be assisted by an advisory council, consisting of the chairman of all the trade councils, and should comprise special departments for export and tariffs, industrial and scientific research, commercial education, statistics and finance, welfare and exhibitions and advertising.

Generally, the scheme involves the establishment of a complete new system of trade government comparable to our existing system of local government, with a ministry at the head with powers similar to those of the local government board, controlling numerous trade councils, with powers comparable to those of existing county councils. It recognizes the essential principle that industrial interests should be grouped by trades and not by localities.

The manifesto, signed as it is largely by manufacturers and officers of employers' associations, is described definitely as an olive branch to labor. It invites the workers cordially to join with the management in the self-government of industry, and offers them an equal status and responsibility on the controlling body. (*Journal of Commerce*, October 27, 1917, p. 2)

International Aircraft Standards

The following list of specifications for aircraft has been adopted to date by the International Aircraft Standards Board of the Council of National Defense, F. G. Diffin, Chairman.

1L1. List of specifications
1G1. General specifications for the testing and inspection of metallic materials
1A1. Methods of chemical analysis
2S1. Chemical compositions of steels
2N1. Ingot aluminum
2N2. Ingot copper
2N3. Spelter
3S1. Carbon steel for case-hardening
3S2. Medium-carbon steel bars and billets
3S3. Alloy-steel bars and billets, 100,000 lb. per sq. in. tensile strength
3S4. Alloy-steel bars and billets, 125,000 lb. per sq. in. tensile strength
3S5. Alloy-steel bars and billets, 150,000 lb. per sq. in. tensile strength
3S6. Alloy-steel bars and billets, 175,000 lb. per sq. in. tensile strength
3S7. Alloy-steel bars and billets, 200,000 lb. per sq. in. tensile strength
3S8. Alloy-steel bars and billets, 225,000 lb. per sq. in. tensile strength
3S9. Alloy-steel bars and billets for case-hardening, 170,000 lb. per sq. in. tensile strength
3S10. Alloy-steel bars and billets for case-hardening, 190,000 lb. per sq. in. tensile strength
3S11. Tolerance on steel bars
3S12. High-strength steel wire
3S13. 19 non-flexible steel-wire cable
3S14. 7 by 7 non-flexible steel-wire cable
3S15. 7 by 19 extra-flexible steel-wire cable
3S16. Wire for acetylene welding
3S17. Wire for electric welding
3N1. Gun-metal castings
3N2. Manganese-bronze castings
3N3. Phosphor-bronze castings
3N4. Naval brass or equivalent alloy bars
3N5. Naval brass or equivalent alloy sheet
3N6. Sheet brass
3N7. Brass tubes
3N8. Sheet copper
3N9. Phosphor-bronze strip
3N10. Babbitt metal
3N11. Aluminum-alloy castings
3N12. Sheet aluminum
4P1. Turnbuckles
4P2. Ferrules and thimbles.

Wood for Aeroplanes

The Forest Service, Department of Agriculture, authorizes the following:

When the United States entered the war the need for wood to build airplanes quickly created a difficult problem. Most of the air-seasoned wood available had been bought for air-

planes for the allied nations abroad. Thorough air seasoning of such stock requires from one to three years, according to the size and kind of wood. Kiln-dried stock under the methods ordinarily used has frequently proved unsatisfactory and for that reason airplane manufacturers have been reluctant to use it. If the needs of the fighting forces were to be met adequately and without prolonged delay, it was essential that methods of conditioning should be available in which full confidence could be placed.

Long before this situation developed the forest products laboratory of the Forest Service, at Madison, Wis., had been making a scientific study of the drying of wood, and had developed a method of drying which has been very successful with all the woods tried. Several kilns have been built at the laboratory for experimental purposes and a number of demonstrations made in commercial kilns. Ash and spruce are the woods most in demand for airplane construction, and anticipating the present situation the Forest Service secured a shipment of partially air-seasoned ash and spruce plank for preliminary tests.

This material was kiln-dried without injury. Later thoroughly green Sitka spruce, white ash (northern and southern), white oak, Douglas fir, western white pine, and mahogany were secured in the log for testing. The spruce and ash logs were cut up and the green material from each species divided into three matched groups. One group of each species was tested green, another had been set aside to be tested when it has air-dried, and the third group was kiln-dried, trying several methods, and then tested.

Only the results of tests on the spruce have so far been analyzed. Comparison with standard tests which had already been made shows that Sitka spruce can be kiln-dried from the green condition with no more, perhaps less, injury to its mechanical properties than by air seasoning. Definite specifications have been prepared for kiln-drying spruce green from the saw for airplane construction, and if rigidly enforced, they will insure kiln-dried stock of this species equal to air-dried stock.

A preliminary study of propeller construction has shown the need of such information on propeller woods. The testing of the ash and other species now on hand, which include several propeller woods, is being pushed as rapidly as possible, and there seems reason to expect as favorable results as for the spruce. (*Official Bulletin*, October 18, 1917, p. 5)

Smoking Rules for Factories Adopted

Announcement is made by the New York State Industrial Commission that it has adopted the new "smoking rules" as Rule 15 of the Industrial Code, to take effect immediately. This gives the new rules force and effect of law.

According to the rule, smoking may now be permitted in a factory only upon written application by an employer, approved by the State Industrial Commission after inspection by its staff and under certain conditions to be prescribed. The permit shall state the conditions under which each individual permit is issued.

As a general proposition, aside from those conditions hereinbefore specified, smoking may be permitted where conditions are substantially as follows: (1) In buildings where the contents are either non-inflammable or incombustible. (2) In buildings of mill construction where the contents are incombustible. (3) In factory buildings, in separate rooms set apart for the purpose as mentioned before. (4) In foundries and forge shops.

No permit will be issued for smoking in any factory where explosives are manufactured, used or stored. Where smoking is permitted fireproof receptacles must be provided in which to deposit all waste or other inflammable material. Wherever smoking is permitted, the use of celluloid eyeshades, cuff protectors, or other similar devices is prohibited. Portions of any factory where smoking is permitted must be posted. (*Journal of Commerce*, October 29, 1917, p. 17)

Weights of Mercedes Motor Parts

The following interesting table is a recapitulation of the weights of the parts of the Mercedes motor:

Crankshaft complete	34.8	kg.
Lower half of crank case	39.97	kg.
Upper half of crank case	31.	kg.
Six cylinders complete	61.24	kg.
Six connecting rods complete	13.86	kg.
Six pistons complete	18.7	kg.
Camshaft complete	21.1	kg.
Carburetor	6.6	kg.
Water pump with shaft and housing	6.6	kg.
Oil pump with shaft	5.85	kg.
Two operating magnetos	13.	kg.
One starting magneto	4.	kg.
Inlet pipe and ignition wire casing	11.	kg.
Miscellaneous parts	5.5	kg.
Total	273.22	kg.
Exhaust pipe complete	7.5	kg.
Radiator empty	26.	kg.
Total	306.72	kg.

This Month's Abstracts

New ways to burn crude oil or gas attract an increasing amount of attention in these days of fuel stringency. In the present issue abstracts will be found of descriptions of two such ways; one by W. A. Janssen and the other by A. C. Ionides.

In the section Air Pumps is described the Globe-Johnston rotary vacuum air pump, said to produce a high vacuum.

The section Engineering Materials is particularly rich in good articles this month.

An abstract from a paper before the Ceramic Society of Glasgow presents an explanation why silica brick is so much more resistant in high-temperature firing than ordinary brick.

Guillery gives new data and methods for obtaining more reliable results with the Brinell hardness test.

Prof. W. M. Thornton, by repeating tests formerly carried out at the National Physical Laboratory, determines the factors affecting the heat-insulating value of a roofing material and presents data on the behavior of such materials.

Grain-size inheritance in iron and carbon steel forms the subject of a paper before the American Institute of Mining Engineers, while Herbert J. French gives data obtained in an experimental investigation of the physical-chemical properties of chrome-nickel steels. Finally, several abstracts taken indirectly from German periodicals are reproduced in the same section.

In the section Internal-Combustion Engineering attention is called to an abstract of a French official report on the use of alcohol for fuel purposes in internal-combustion engines and some details of the new Evinrude-Hvid oil engine.

Tables and data are reproduced from a British periodical on the design of coil springs.

In the section Thermodynamics particular attention is called to an abstract of paper by W. C. Stuart, Mem.Am.Soc.M.E., on the performance and design of surface feedwater heaters. Lack of space prevented giving a more detailed abstract of this interesting paper.

REVIEW OF ENGINEERING PERIODICALS

SUBJECTS OF THIS MONTH'S ABSTRACTS

CAST-IRON AEROPLANE-ENGINE CYLINDERS.
WATER TESTS OF AEROPLANE-ENGINE CYLINDERS.
GLOBE-JOHNSTON ROTARY VACUUM AIR PUMP.
REFRACTORY PROPERTIES OF SILICA.
SILICA AND CLAY BRICKS COMPARED.
CRUSHING RESISTANCE OF SILICA BRICKS.
BRINELL HARDNESS TESTING OF METALS.
GUILLERY APPARATUS FOR ADJUSTING THE PRESSURE IN THE BRINELL HARDNESS TEST.
POSSIBLE ERRORS IN BRINELL HARDNESS TESTS.
HEAT INSULATING VALUE OF ROOFING MATERIALS.
FIBROCEMENT.
GRAIN-SIZE INHERITANCE IN IRON AND CARBON STEEL.
RATE OF COOLING OF IRON AND GRAIN SIZE.
PHYSICO-CHEMICAL PROPERTIES OF CHROME-NICKEL STEEL.
CHROME-NICKEL STEEL AND HEAT TREATMENT.
STRUCTURE OF SCHOOP SPRAYED-METAL COATING.
HARDNESS OF COMMERCIAL ALLOYS.
PROPERTIES OF SHEET COPPER AND DIRECTION OF ROLLING.
JANSSEN METHOD OF BURNING CRUDE OIL.
PROPORTIONING CHIMNEYS ON FUEL BASIS.
COMPOSITION OF CHIMNEY GASES.
CHIMNEY HEIGHT.
IONIDES SYSTEM OF GAS FIRING.
IONIDES MIXING BALANCE FOR GAS FIRING.
GAS-FURNACE INDICATOR.
COAL AND FEEDWATER HANDLING AT ST. JOSEPH, MO., PLANT.
ALCOHOL AS FUEL.
HVID-EVINRUDE OIL ENGINE.
DESIGN OF COIL SPRINGS.
CORROSION OF BRINE PIPES.
SANTA FE LOCOMOTIVE FOR U. P.
AUTOMATIC STRAIGHT AIR-BRAKE SYSTEM
NEW AIR-BRAKE TRIPLE VALVE.
SURFACE FEEDWATER HEATERS.
CURVE OF TEMPERATURE RISE IN FEEDWATER HEATERS.
MEAN TEMPERATURE DIFFERENCE AND HEAT-TRANSFER COEFFICIENT.

Aeronautics

THE METALLURGY OF CAST-IRON AEROPLANE-ENGINE CYLINDERS, F. W. ADAMS

An article giving data on the mixtures and processes used in the casting of cast-iron aeroplane-engine cylinders.

The tests used are chemical analysis, water-pressure test for porosity, and size-limit test.

The chemical constitution of the iron is specified and usually allows of but little variation, the mixture aimed at being such as will make a cylinder sufficiently hard to insure a reasonable life, but, at the same time, machinable and not porous.

Owing to the thinness of the casting, phosphorus must be relatively high in order to promote fluidity and enable the metal to take the finest parts of the mold. As phosphorus, however, produces brittleness in the iron under shock, its excess must be carefully avoided. Fluidity can also be produced by a high melting temperature, but this has several disadvantages. In the first place more carbon is absorbed by the molten metal, and next, on casting, rapid cooling takes place at critical temperatures, resulting in brittleness and hard patches in the finished casting which cause considerable trouble in machining.

The water test is of great importance. The machined cylinders are tested up to a water pressure of 500 lb. per sq. in. and at this pressure must not show the slightest trace of leakage or even dampness on the outside surface. Failure in this case may be due either to excessive graphitic carbon or blowholes. In the first case a slight leakage usually occurs in the thinner portions of the cylinder and is apparently due to lack of cohesion between the graphite plates and the metal itself.

The original is illustrated by photomicrographs showing the structure of various types of cylinder cast iron. (*Aerial Age Weekly*, vol. 6, no. 7, October 29, 1917, pp. 286-287, 6 figs., *p*)

Air Pumps

GLOBE-JOHNSTON ROTARY VACUUM AIR PUMP

Description of a rotary valveless air pump designed to produce a high vacuum.

It consists of two main parts, the rotor and the drum, rotating on ball bearings in a specially designed casing. By a small modification the vacuum pump may be converted into an air compressor.

The rotor, Fig. 1, as applied for the vacuum pump, is a hollow member on the outer circumference of which deep double-thread screws are formed. A passage *C* runs between twin-screw threads *A* and *B* into the interior of the rotor. When the machine is producing a vacuum this passage acts as the inlet to the screw threads, but when air is being compressed, it is the outlet. Similarly the pipe *F* running from the interior of the rotor to the exterior of the machine is the inlet pipe in the vacuum pump and the outlet pipe in the compressor. The screw threads are joined by a large number of narrow partitions or blades *D* which are equally spaced around

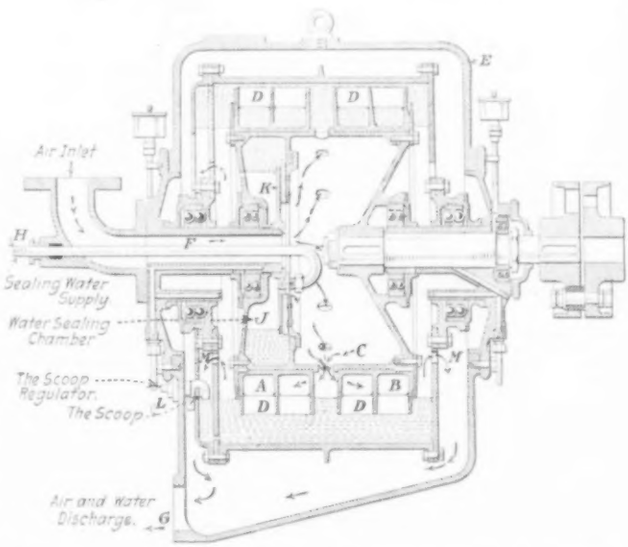


FIG. 1 GLOBE-JOHNSTON ROTARY VACUUM PUMP IN SECTION

the periphery of the rotor. The outer and inner edges of these blades are respectively flush with the top of the screw threads and half way down the depth of the threads.

The ring of water is in the first place set up by the action of these blades in conjunction with centrifugal force. Annular rings *E*, called shrouding blades, fitted to the sides of the rotor and reaching somewhat below the water level on the discharge side, prevent the exhausted or compressed air from returning along the screws when the thread ends leave the water seal.

The rotating drum is a hollow cylinder also running on massive ball bearings. The drum when rotating contains the ring of water and is set eccentrically to the rotor. The relative eccentricity of the rotor and the water ring produces what is called the "working space," Fig. 2. The net circular

area of this space considered in conjunction with the pitch of the screw threads and the speed of rotation is the measure of the air capacity of the pump.

The essential feature of this pump is a rotating screw set eccentrically to and working in conjunction with a ring of water established and maintained by centrifugal force within the rotating drum. To put the machine into operation water is allowed to flow through pipe *H*, Fig. 1, and the pump is set in motion. The water passes through the water-sealing chamber *J* to the interior of the pump, which it gradually fills until it becomes deep enough to be caught by the partition blades *D* of the revolving-screw rotors *A* and *B*. It is then whirled round the interior of the rotating drum *C* by these blades.

The friction between the whirling water and the drum causes the latter to revolve also and in a very short time the drum and the rotor are running at practically the same speed. The sealing water continues to flow into the machine until a ring of water is formed within the drum sufficiently deep to submerge the screw threads on the rotor at the point where,

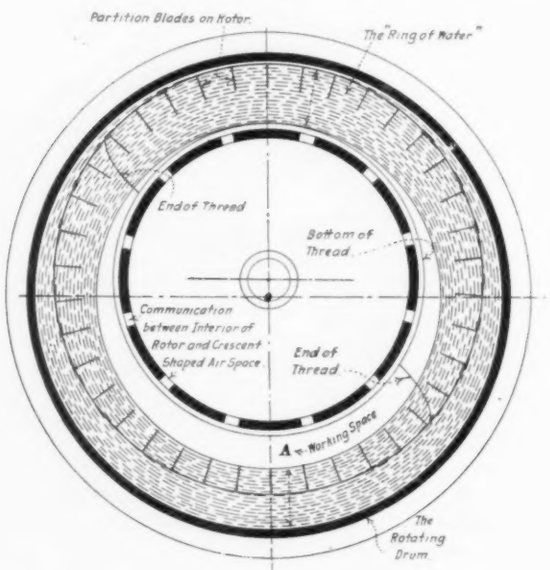

Partition Blades on Rotor
The "Ring of Water"
End of Thread
Bottom of Thread
Communication between Interior of Rotor and Crescent Shaped Air Space
End of Thread
A = Working Space
The Rotating Drum

FIG. 2 SECTION SHOWING RING OF WATER IN THE GLOBE-JOHNSTON ROTARY VACUUM PUMP

due to the eccentricity, they approach nearest to the inner periphery of the drum. It is this water maintained in the form of a ring within the drum by centrifugal force operating in connection with the threaded rotor set eccentrically to it, that produces the pump effect.

During the operation of the pump a small stream of water flows continuously into the drum through the pipe *H*, Fig. 1, and in order to maintain the correct depth in the ring of water a scoop *L* is provided. The scoop skims half the surplus water and does it continuously while the pump is working. (*Steamship*, vol. 29, no. 340, October 1917, pp. 75-79, 7 figs., *d*)

Engineering Materials

THE REFRACTORY PROPERTIES OF SILICA, H. LeChatelier and B. Bogitch

It has been found that with clay bricks the arches could not bear the temperature in regenerative firing and would give way in a very short time. On the other hand, silica bricks could stand that temperature. It has not been clear, however, why silica brick is so superior to clay brick. The experiments on the refractory properties of clay carried on by the present investigators give a basis for the explanation of this fact. It appears that clay bricks begin to soften between 1300 and 1400 deg. cent., and, therefore, above that temperature cannot sustain heavy loads without giving way in a continuous and indefinite manner.

They act, therefore, like a vitreous substance, and have no real fusing point, but only an extensive fusibility range.

The difference in the ways in which clay and quartz act is based on the assumption that the latter has a real point of fusion without previous softening, and, consequently, independent of pressure. This has been confirmed experimentally by the writers. When toward 1500 deg. a small cylinder of clay is crushed it can be seen dilating into barrel shape, then completely flattened out into a thin cake, with rounded edges showing, at any moment, properly so-called fracture. When cooled, the crushed mass entirely preserves its former hardness. On the other hand, in the case of a silicon, the first application of the pressure produces no appreciable effect, but on increasing it gradually the test piece breaks abruptly, showing two sliding cones, which are observed in hard materials when working under compression, and the broken fragments do not reunite at all during the cooling. The effort necessary to produce this abrupt breakage decreases gradually with rise of temperature.

The resistance in crushing expressed in kg. per sq. cm. or lb. per sq. in. begins with 170 kg. (2400 lb. per sq. in.) at 15 deg. cent., 120 kg. (1700 lb. per sq. in.) at 1050 deg. cent., and 30 kg. (425 lb. per sq. in.) at 1600 deg cent. These numbers lead by extrapolation to a resistance of 12 kg. (170 lb. per sq. in.) at 1700 deg. cent., the usual temperature of the arches in steel furnaces, a resistance which is about ten times the load sustained by the bricks in the arches. This mechanical resistance, retained up to very high temperatures, is a special peculiarity of silica bricks, and is not found in clay bricks or even in magnesia bricks less fusible than silica.

The reason of the difference is that both clay and magnesia bricks contain basic oxides, such as aluminum, lime, oxides of iron, etc., which all tend to produce a fusible material liquid already toward 1200 deg. Silica, on the contrary, forms a continuous network, in the pores of which the melted mass lodges like water lodges in the pores of pumice stone without diminishing the mechanical resistance. The formation of this network, in consequence of the recrystallization of the silica, is due to the difference of solubility of the different allotropic varieties of silica.

Bricks insufficiently fired whose network is not yet formed are composed of grains of quartz flowing in the metal mass and are plastic like the clay bricks. This explains why insufficiently fired bricks are fusible and useless. When a good silica brick is heated, its strength diminishes with rise of temperature. The reason for this is that the solubility of silica increases with the temperature, and therefore a progressive dissolution of the crystalline network is produced which tends to disintegrate it. This effect is the more delayed the better the network is developed, and it is on this that the quality of silica brick depends before anything else. The problem is, therefore, to study the factors on which the rigidity of the network depends, and these factors appear to be as follows: the proportion of fluxes; the actual temperature of the brick; the good formation of the network; the disintegration of the network through subsequent swelling out.

As regards fluxes, it has been found that the weights of the oxides in the fluxes represent a particularly constant fraction of the weights of the sulphates, on an average 35 per cent.

The temperature which the brick supports depends entirely on the use one wishes to make of it. The highest temperature is in steel furnaces. In ovens for the distillation of coal the temperature is not so high, and, therefore, a double proportion of the basic oxides can be used in the brick which makes its manufacture easier.

The proper constitution of the network is the most delicate part of the manufacture. In order to develop the network, the brick must be kept for a very long time at such a high temperature that the melted magma may be sufficiently fluid. The most favorable conditions appear to be several days firing at a temperature approaching 1450 deg. cent.

The writers state, in conclusion, that all good bricks after heating for an hour at 1600 deg. cent. offer a resistance to crushing at least equal to 10 kg. per sq. cm. The prolongation of heating at this temperature does not materially diminish their strength as compared to what happens with bad bricks. (Abstract of a paper read before the Ceramic Society at Glasgow on October 2, 1917, through *Engineering*, vol. 104, no. 2702, October 12, 1917, pp. 396, *e*)

BRINELL HARDNESS TESTING OF METALS, M. Guillery

In order to have the results of the Brinell hardness test comparable with each other it is necessary to define the conditions of the test. In the case of steel it is usual to specify them as follows:

Diameter of the ball, 10 mm.

Total pressure, 3000 kg.

Duration of pressure, at least 5 min.

The first two of these conditions are easy to specify, but the third, while theoretically very simple, is in practice impossible to satisfy except in scientific laboratories. In a shop where the number of tests often exceeds 10,000 a day, it is evidently impossible to continue the pressure in each test for 5 min. and it is usual to keep the pressure only for 10 sec. This is liable to cause an error sometimes as high as 8 per cent.

The writer cites the following figures obtained with a constant speed of ball and the pressure being removed as soon as it attained 3000 kg. (Table 1.)

TABLE 1 DATA OF HARDNESS TESTS ON VARIOUS MATERIALS

Impact velocity, kg. per sec.	Dia. mm.	Error	Brinell hardness kg. per sq. mm.	Error	Tensile strength, kg. per sq. mm.	Error	Error per cent
MILD STEEL							
0	4.74	0	159	0	55.6	0	0
12.5.....	4.72	0.02	161	2	56.3	0.7	1.2
25	4.70	0.04	163	4	57.0	1.4	2.4
1500	4.60	0.14	171	8	59.8	4.2	7.1
MEDIUM STEEL TEMPERED AND ANNEALED							
0	4.094	0	212.5	0	74.3	0	0
12.5.....	4.074	0.020	217	4.5	76.0	1.7	2.2
25	4.059	0.035	221.5	9	77.6	3.3	4.3
1500	3.975	0.118	227	14.5	79.4	5.4	7

A very simple mechanical arrangement makes it possible to eliminate this source of error. If the pressure is removed as soon as 3000 kg. are attained, the diameter of imprint will be too small by a quantity dD. If, on the other hand, instead of the pressure being stopped at 3000 kg. it is carried to $3000 + dP$, then the diameter of imprint will be increased Now, if a suitable value of dP is selected, then the error resulting from insufficient duration of action of pressure will be exactly compensated. As a matter of fact, we will have essentially the relation

$$\frac{dP}{3000} = \frac{2dD}{D}$$

With an impact of 1500 kg. per sec. we have for the first steel in the above table $dD = 0.14$. Hence,

$$dP = 3000\frac{2 \times 0.14}{4.74} = 177 \text{ kg.}$$

It is quite possible to build an apparatus in which the maximum pressure attained will be regulated by the velocity of impact.

Let us assume that the pressure is transmitted to the ball

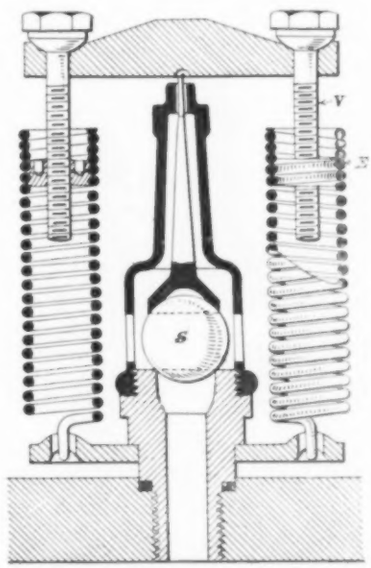


FIG. 3 GUILLERY APPARATUS FOR ADJUSTING THE PRESSURE IN THE BRINELL HARDNESS TEST

by a frictionless hydraulic piston in which the watertightness is insured by a strip of rubber. The pressure exerted on the piston is limited by the lift of the valve formed by the sphere S, Fig. 3, carried in a sharp-angle seat. The pressure necessary to lift the valve is then strictly determined by the full section of the seat and the effort applied to the sphere. This effort is produced by the springs, the tension of which may be varied as desired by means of the tightening nuts D, and the useful length, by means of the screws E which act on the spirals themselves of the springs at rest.

For purposes of regulation this arrangement gives two independent variables: length and tension of the spring. The effort opposing the lift of the valve depends on the height of this lift, which increases the elongation, and hence the tension of the spring. The apparatus is regulated by "cut and try," so as to have on a given steel the normal diameters of imprint for two velocities of impact varying

in the ratio of 1 to 30. The apparatus is at the same time adjusted for all the intermediary velocities, as shown by Table 2.

TABLE 2 DATA OF HARDNESS TESTS ON AN IMPROVED BRINELL-GUILLERY APPARATUS

Velocity of impact, kg. per sec.	100	200	300	600	1000	1500	3000
Diameter of imprint	4.38	4.37	4.40	4.39	4.40	4.39	4.39

TABLE 3 FURTHER DATA OF TESTS ON VARIOUS MATERIALS

	Velocity of impact, in kg. per sec.				
	12.5	100	600	3000	
Mild steel	5.67	5.66	5.67	5.68	5.66
Medium steel, tempered and annealed	4.40	4.36	4.36	4.36	4.36
Nickel-chrome, untreated	3.63	3.60	3.59	3.62	3.58
Nickel-chrome, annealed	2.61	2.62	2.62	2.63	2.60

Theoretically a new regulation should be made for each different metal. However, for ordinary carbon steels and for such special steels as chrome and chrome nickel which have undergone some heat treatment the same regulation holds good, as shown by the following results, Table 3.

This apparatus has been functioning for several months without having ever gotten out of order. On pieces of the same shape and easy to handle the testing is done at the rate of 600 imprints per hour. Of the 10 sec. employed for each operation 8 sec. are for the manipulations and 2 sec. for applying pressure. (*Essai de dureté des métaux à la bille Brinell, Guillery, Comptes rendus de séances de l'Académie des Sciences,* vol. 165, no. 15, October 8, 1917, pp. 468-471, 1 fig., *e*)

THE HEAT-INSULATING VALUE OF ROOFING MATERIALS, Prof. W. M. Thornton

In the last-but-one report of the National Physical Laboratory, there is an account of a test of roofing by means of measuring the heat lost from a heated room, which leads to the remarkable conclusion that the rate of emission of heat by the radiation from the covering surface has more effect on the inside temperature than the rate of conduction of heat through the material.

This result is of importance in the roofing of large factories of semi-permanent nature where the temperature depends more upon the covering than in the case of buildings having a closed air space under the roof. In the present case the test of the National Physical Laboratory was repeated by a method the reverse of that used by them; namely, instead of heating a room and measuring the heat lost through the roof, a smaller chamber was made by bolting together slabs of 3-in. thick "nonpareil" cork and exposing its cover to strong radiation. The box was made 18 in. square and 2 ft. deep inside, so that slabs of roofing of convenient size, such as slates, could be placed in position to cover the chamber without requiring special support.

The test consisted in observing the rate of rise of temperature in the chamber from the time the radiation was applied. The method was such as to give good comparative values.

The results obtained confirm the National Physical Laboratory conclusion that the heat-insulating value of a roofing material depends more upon the nature of its surface than upon its thermal conductivity. A sheet of galvanized iron was obtained having a practically mirrorlike surface. Only 111 heat units entered per 1000 sq. ft. per hour, but that the heat transmitted depends largely on surface conditions was seen at once by the increased rate of transmission caused by blackening the surface facing *into* the box, the other surface being unchanged. Reversing the plate so that the outer surface was black and the inner bright more than doubled the lost rate, and when both surfaces were blackened, the large amount of 581 units per hour was transmitted.

A suggestion was made in the National Physical Laboratory report that air spaces in roofing materials might be advantageous. A satisfactory means of doing this is to lay corrugated asbestos cement plates on the thinnest asphalted felt, or any other light sheet material, supported by the roof frames. The effect of this, as seen from the table, is equal to that of an aluminum surface, and where heat insulation and lightness are of the first importance, a strong and efficient roofing can be made in this way at a reasonable cost.

TABLE 4 HEAT TRANSMITTED THROUGH ROOFING MATERIAL EXPOSED TO STRONG RADIATION

	Material	Rise of temperature in testing chamber, deg. cent. per min.	B.t.u. per 100 sq. ft. per hour	Thickness in inches	Weight, lb. per sq. ft.
1	Bright galvanized iron sheet	0.268	111	0.04	1.6
2	Galvanized iron, blackened below	0.40	168	0.04	1.6
3	Galvanized iron, blackened above	0.93	385	0.04	1.6
4	Galvanized iron blackened above and below	1.40	581	0.04	1.6
5	Galvanized corrugated iron after one month's exposure to the weather	0.75	310	0.033	1.28
6	Do., after one year's exposure	1.02	422	0.033	1.28
7	No. 6, painted black above	1.13	472	0.033	1.28
8	Roofing glass, serrated	1.10	453	0.22	2.25
9	Welsh slate	0.81	337	0.17	2.0
10	Westmoreland slate	0.60	248	0.25	4.8
11	7/8-in. T. G. deal covered with asphalted felt	0.30	124	1.0	2.6
12	Corrugated fibrocement after one month in use	0.78	325	0.2	1.8
13	Do., after one year in use	0.80	334	0.2	1.8
14	Do., painted dead black	0.82	341	0.2	1.8
15	Do., "aluminum-finished" outside	0.50	207	0.2	1.8
16	Do., laid on top of thin asphalted felt	0.51	211	0.25	2.0

The main data obtained in the test are presented in Table 4. The "fibrocement" referred to in the table is an artificial roofing material containing asbestos manufactured by a British company. (*Engineering,* vol. 104, no. 2703, October 19, 1917, pp. 405-406, *e*.)

GRAIN-SIZE INHERITANCE IN IRON AND CARBON STEEL, Zay Jeffries

Discussion of the question of inheritance of ferrite grain size from that of austenite, together with the general question of grain refining in steel and iron.

The writer reports on series of tests on grain size in transformation products of iron and steel such as 0.7 per cent carbon steel (in this series of tests, among other things, data were found giving an explanation why cast steel has its grain better refined after two heatings and coolings than after one), 0.2 per cent carbon steel, Armco iron, and finally electrolytic iron.

Because of lack of space only the conclusions reached can be reported here.

1 The ferrite grain size in pure iron, the ferrite and pearlite grain size in hypoeutectoid steel, the pearlite grain size in eutectoid steel and the cementite and pearlite grain size of hypereutectoid steel are not inherited from the grain size of the mother austenite.

2 The only structural feature that is generally inherited from the austenite of hypo- and hypereutectoid steels on cooling through their transformation ranges is the position of the excess ferrite or cementite at the austenite grain boundaries, sometimes causing complete and sometimes incomplete networks which outline the old austenite grain boundaries. Rapid cooling through the transformation range will cause the non-inheritance of this structural (network) feature.

3 The austenite grain boundaries themselves are nearly always effaced in all steels, and also in pure iron during the *Ar* transformations.

4 The grain-size refining of steel and iron is brought about by the combined effect of non-inheritance of the transformation products on either heating or cooling, i.e., the austenite transformation products do not inherit their grain size from the austenite on cooling through the transformation range, nor does austenite inherit its grain size from the products which form austenite on heating.

5 In general, in both iron and carbon steel, the larger the austenite grain size, the larger will be the grain size of the transformation products on cooling. This, of course, assumes all other conditions constant except the austenite grain size. An exception is found to this general rule in very pure iron such as electrolytic iron. In this instance small austenite grains may form very large ferrite grains on cooling through Ar_3.

6 In iron and steel, the larger the ferrite, cementite or pearlite grain size, the larger will be the austenite grain size on heating above the *Ac* transformations, or vice versa.

7 The faster the rate of cooling of iron and steel through the *Ar* transformation range, the smaller will be the grain size of the transformation products and vice versa.

8 The faster the rate of heating of iron and steel, other conditions remaining the same, the smaller will be the austenite grain size.

9 The greater the temperature gradient during the transformations in iron and steel on heating or cooling, the larger will be the grain size.

10 If the grain size of a transformation product in iron and steel immediately after the transformation is smaller than the equilibrium grain size of that product under the existing conditions, the equilibrium grain size will be established by the known laws of grain growth.

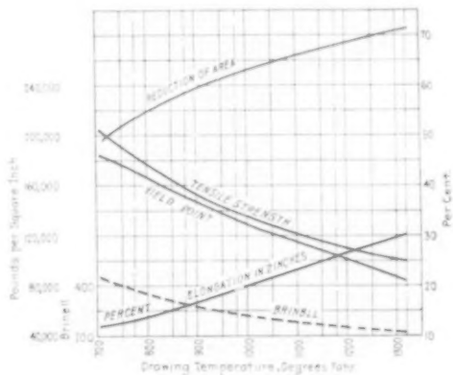
11 A single grain of any constituent in iron or steel (austenite, ferrite, pearlite), when forced by thermal treatment to undergo one of the *A* transformations, must transform from at least one nucleus, but may and nearly always does transform more than one nucleus. (*Bulletin of the American Institute of Mining Engineers*, no. 131, November 1917, pp. 1883-1899, 5 figs., 3 tables, *te*)

PHYSICO-CHEMICAL PROPERTIES OF CHROME-NICKEL STEELS, Herbert J. French

Data of tests designed to show the properties which may be developed by heat treatment of certain chrome-nickel steels, especially those lately employed for automobile and aeroplane engine construction.

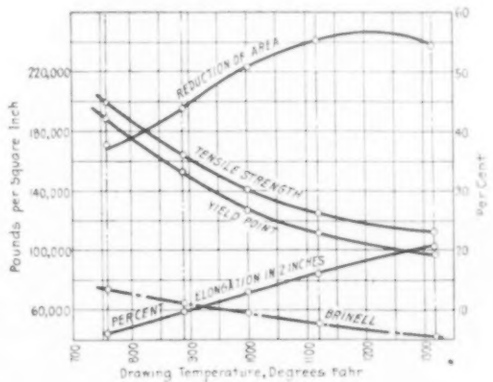
Standard tensile test specimens (0.505 in. by 2 in.) were heat-treated in a laboratory electric furnace, and the results thus obtained were then checked in actual production by including standard test sections in the ordinary large oil-fired furnaces. All temperatures are given in degrees fahrenheit.

In quenching care was taken to introduce the steel into the oil as quickly as possible after leaving the furnace. It was then kept in motion in the oil for about 1 min.



C	0.35	P	0.014	Cr	0.50
Mn	0.64	Ni	1.47	S	0.023

FIG. 4 OPEN HEARTH. FORGED TO ABOUT 1 IN. ROUND. OIL-QUENCHED 1470 DEG. FAHR. DRAWN AS GIVEN.



C	0.43	PS	low	Cr	0.72
Mn	0.52	Ni	1.16		

FIG. 5 OPEN-HEARTH. FORGED TO ABOUT 1 IN. ROUND AND HEAT-TREATED. OIL-QUENCHED 1475 DEG. FAHR. DRAWN AS GIVEN

Tensile test values shown in Figs. 4 and 5 serve to give a good idea of the physical properties which may be developed by heat-treating steel of the following standard specification:

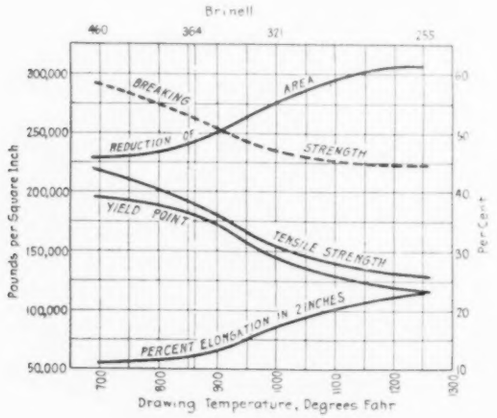
	Per Cent
Carbon	0.35—0.45
Nickel	1.00—1.50
Chromium	0.50—0.75
Manganese	0.50—0.80
Phosphorus, max	0.04
Sulphur, max	0.04

The article contains data on two other steels with high nickel and chromium contents. A good representative of such is Fig. 6, where the nickel content rises to 2.56 per cent and the chromium content to 1.01 per cent. In all, five types of steel are discussed.

These steels have been used, among other purposes, for the development of the Gnome-type aeroplane engine in the United States, and it is stated that they are suited for automobile work.

It must be borne in mind, however, that steels of high nickel and chromium content are very susceptible to improper working under the hammer. This refers particularly to heat *D* shown in Fig. 6. Lower chrome-nickel steels will stand more abuse in manufacturing, and will show the effects of improper working to a less marked degree. What is especially to be avoided is too rapid heating, and particularly heating in an open fire, which leaves the center of the mass of metal cold and the outside "dripping." Quite often the effect of cold working is less serious than when the whole mass of steel uniformly heated is hammered at too low a temperature. This condition of strain can be obliterated if proper heat-treatment methods are employed.

Ordinary annealing may soften the steel so that the hard-



C	0.39	P	0.016	Cr	1.013
Mn	0.36	Ni	2.56	S	0.016

FIG. 6 ACID OPEN-HEARTH. FORGED TO ABOUT 1 IN. ROUND. HEAT-TREATED. OIL-QUENCHED 1475 DEG. FAHR. DRAWN AS GIVEN

ness test will show nearly normal results, but machining will still be difficult. (*Metallurgical and Chemical Engineering*, vol. 17, no. 8, October 15, 1917, pp. 473-476, 10 figs., *e*)

STRUCTURE OF SCHOOP SPRAYED-METAL COATING, H. Arnold (*Zeits. Anorg. Chem.* 99. 1. pp. 67-72, March 15, 1917, *Engineering* 104, p. 126, August 3, 1917.)

Examining the coatings microscopically (photographs reproduced) the author, of the Metallisator Gesell., finds that the drop of fusing metal is drawn out, by the gas and air currents, into a thread which breaks up into small particles; in the case of aluminum the particles form splashes, from 0.01 to 0.15 mm. in diameter, provided with a short tail and showing a dendritic structure. Polishing and etching of the coatings brings out wavy lines. Zinc, sprayed on glass, partly peels off again and contracts to irregular crescents; tin forms rings, frequently double rings. There is no alloying of two sprayed metals, except perhaps with lead and antimony, unless subsequent heating follows; the union is merely mechanical. Microscopically spray coatings, even of aluminum rolled into iron, can be distinguished from electrolytic and other deposits. (*Science Abstracts*, Section B. Electrical Engineering, vol. 20, part 9 [No. 237], September 29, 1917, p. 307)

HARDNESS OF COMMERCIAL ALLOYS, P. Ludwik (*Zeits. Vereines Deutsch. Ing.*, 61. pp. 549-554, June 30, 1917.)

Gives the results of measurements of hardness of a large number of the most important technical alloys of Cu, Sn, Pb, Zn, Al, Bi, Mg, Sb, Ag, with the five first-named metals in various proportions and combinations. These alloys include aluminum bronze, german silver, manganin, white metal, magnalium, etc. (*Science Abstracts*, Section B, Electrical Engineering, vol. 20, part 9 [No. 237], September 29, 1917, p. 305)

INFLUENCE OF THE METHOD OF PRODUCTION AND THE DIRECTION OF ROLLING ON THE PROPERTIES OF SHEET COPPER ROLLED TO VARIOUS THICKNESSES, W. Müller (*Zeits. Vereines Deutsch. Ing.*, 61. pp. 65-67, January 27, 1917.)

The tensile strength of sheet copper increases steadily with the reduction in rolling, the yield point increasing rapidly up to 20-30 per cent reduction; above this it is proportional to the ultimate strength. The elongation falls rapidly until the reduction in rolling attains 20-30 per cent, after which it remains nearly constant. With regard to the influence of the method of production, the modulus of elasticity is affected most in that the larger the grain size the higher the modulus. The hardness and the tensile strength, however, decrease with increase in grain size. No previous systematic investigation has been made of the influence of direction of rolling on mechanical properties, but it is generally assumed that the lowest strength is to be found at right angles to the direction of rolling. There appears to be a well-defined connection between the mechanical properties of the test piece and the angle which its axis makes with the direction of rolling; this is best shown by the bending test. Test pieces cut at 30 deg. to the direction of rolling exhibited the maximum resistance to bending. The modulus and tensile strength were found to be greater at right angles to the direction of rolling than in a direction parallel to it. Experiments on annealing showed that the increased strength of the sheets subjected to greatest reduction in rolling, is maintained after annealing at all temperatures. This hysteresis has been confirmed by a study of the specific gravities. (*Science Abstracts*, Section B, Electrical Engineering, vol. 20, part 9 [No. 237], September 29, 1917, p. 305)

Firing

NEW WAY TO BURN CRUDE OIL, W. A. Janssen

During the past year there has been developed a system of oil burning wherein the oil, instead of being atomized or vaporized, is gasefied in a special designed vaporizer outside of the furnace. The gaseous product is forced into a combustion chamber under positive pressure. The air for combustion is delivered by a compressor at about 2 lb. pressure and a velocity of 150 ft. per sec. With the admixture of oil in the vaporizer, a gaseous product is formed which is delivered to the combustion chamber under continuous pressure.

The cast-iron preheater, Fig. 7, consists of a closed cast-iron box with openings to connecting boxes for the admission of incoming air. A series of vertical flues are provided to permit a passage of the outgoing waste gases through the apparatus, thus providing a source of heat for preheating the air for combustion. When more than one preheater is used they are stacked one over the other, so arranged that the inlet

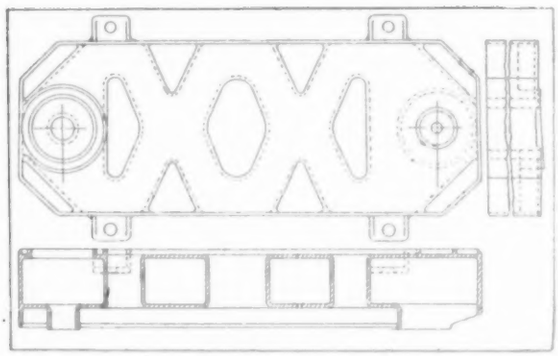


FIG. 7 GENERAL ARRANGEMENT OF THE CAST-IRON PREHEATER

opening of one connects with the outlet opening of another. The purpose of this arrangement is to throw out of line the vertical flues, thereby retarding the flow of outgoing gases and permitting a greater heat absorption through the walls of the preheaters.

The vaporizer, Fig. 8, is a hollow cast-iron fitting. Within it are a series of baffles, which form a winding, zigzag path for the gaseous mixture of the air and oil.

To obtain perfect combustion, the proportions of oil and air must be right and the temperature of the preheated air must also be correct. The installation operates most efficiently when the temperature of the air is about 800 deg. fahr., giving a net temperature of the gaseous mixture of about 700 deg. fahr.

The velocity of the gaseous mixture should be about 150 ft. per sec. in order to prevent flame propagation in the direction of the source. This is most essential, as the temperature of ignition, 1050 deg. fahr., is only a few hundred degrees higher than the temperature of the gaseous mixture.

To the heavy fuel oils of commerce about 180 ft. of free air are required per pound of oil, or about 1500 cu. ft. of free air per gallon—equivalent to 25 cu. ft. of free air per minute per gallon of oil per hour. High economies in oil consumption are claimed for this method. (Paper presented at the Annual Meeting of the American Foundrymen's Association at Boston, September 27, 1917, abstracted through *The Iron Age*, vol. 1, no. 18, November 1, 1917, pp. 1049-1050, 2 figs., *d*)

PROPORTIONING CHIMNEYS ON FUEL BASIS, Henry Wisostow

The writer believes that proportioning chimneys on the basis of formulæ given in handbooks and textbooks is not satisfactory, and suggests a somewhat different method, based on the following considerations:

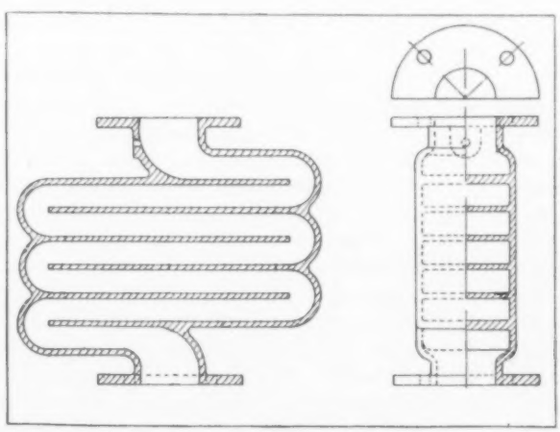


FIG. 8 CAST-IRON VAPORIZER

The object which a chimney should accomplish is twofold: first, it should deliver sufficient fresh air to the fire to maintain combustion; and, second, it must discharge the products of combustion into the atmosphere. Hence, the best chimney is the smallest one that will do the work.

Contrary to the general idea, the composition of chimney gases runs very uniform for the same class of service and differs little with different services. The services may be divided into two classes, low-pressure for heating and high-pressure for heating and power or power alone.

The composition of chimney gases is largely affected by infiltration of air through the setting and into the gas passages. The average results from a large number of chimneys investigated are tabulated, as follows:

	Average CO_2, per cent	Average stack temperature, deg. fahr.	Average velocity, ft. per sec.
Low-pressure heating	4.5	180	10
High-pressure	6.5	450	25

With the percentage of CO_2 given, the weight of the chimney gas can be figured closely. The quantity of the gas and the velocity are the two main factors determining the area of the chimney. Increase of velocity increases the stack loss, but this loss is not very large. Velocities of from 10 to 40 ft. per sec. are met in practice. With high velocities the rate of combustion is increased, which is followed by an increase in temperature, compensating for the increased draft loss due to a higher velocity.

Friction head in the chimney usually remains inside of 0.001 in. of water per lineal foot height of the chimney when the velocity remains under 30 ft.

Chimney height is determined by the amount of draft required. In cases where chimneys must be built higher than this, the area per pound of chimney gas can be reduced in inverse ratio to the square root of the height. The area is determined by the quantity of the gas per second and the velocity. As previously stated, a stack velocity of 25 ft. per sec. is a good working velocity, although for sharp, short peak loads a velocity of 30 ft. per sec. may be used. Chimney friction loss per foot under 30 ft. velocity per second will be inside of 0.001 in. of water. The gas weight may be obtained from the quantity of fuel required. The volume of gas is proportional to the temperature, and this may be taken as 450 deg. fahr. In all calculations absolute temperatures must be used. Draft required divided by the available draft per foot of height will give the stack height.

Available draft per foot of chimney for an average stack temperature of 450 deg. fahr. is equal to the actual difference in weight of the gases inside and outside of the chimney, expressed in inches of water per square inch, less 0.001 in. friction loss.

Composition of chimney gases can be taken as 6.5 per cent of CO_2, 11.5 per cent of O_2, and the rest nitrogen. From these figures the weight and volume can be obtained. Actual composition of the chimney gases varies slightly, there being a trace of CO, SO, SO_2, and slightly more nitrogen than was in the air. This is why the CO_2 and O_2 total 18 per cent in chimney gases instead of over 20 per cent, as in free air.

The quantity of combustible required to provide the desired amount of heat can be taken as composed of pure carbon with

a heat value of 14,000 B.t.u. The combined efficiency of the boiler and furnace can be considered as 60 per cent for high- and 40 for low-pressure plants.

The foregoing data reduced for quick reference in practical work will be as follows: (1) Draft available per foot of chimney above the grate is 0.0053 in. of water; (2) combustible per horsepower, 4 lb.; (3) area required per pound of combustible will be 1.1 sq. in. for high-pressure plants; (4) area correction for chimney above 150 ft. high per pound of combustible is $(1.1 \times 12.24) \div$ (square root of chimney height). (*Power*, vol. 46, no. 18, October 30, 1917, pp. 610-611, *p.*)

PRINCIPLES AND METHODS OF A NEW SYSTEM OF GAS FIRING, A. C. Ionides

The system described employs flues downwardly displaced in order to avoid any possible loss of heat.

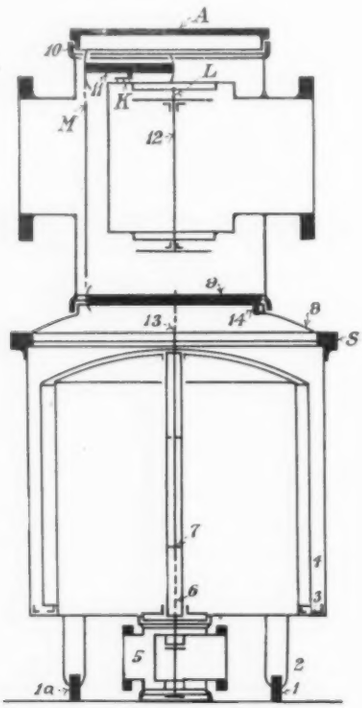


FIG. 9 MIXING BALANCE FOR THE IONIDES SYSTEM OF GAS FIRING

The first problem that presented itself in applying this new principle was that of establishing and maintaining a constant mixture. There are three main variables to be dealt with as regards mixture: first, the inlet pressure of the air; second, the inlet pressure of the gas; third, the variation in consumption of either air or gas that may occur in any given installation.

The first problem was the most difficult to solve, since in many cases, as for domestic purposes, it was necessary to deal with considerable differences of pressure. This problem was solved by the construction of a device which the writer calls a mixing balance.

This balance, Fig. 9, consists of a sensitive bell, 4, with a requisite length of seal. The inside of this bell is subjected to the static pressure of gas and the outside to the static pressure of the air. Hence, when the static pressure of the gas increases, the arrangement is such that the flow of gas cuts itself off and the flow of air is, to some extent, increased. Likewise, when the static pressure of the air above increases, it shuts itself off and opens the gas correspondingly. As a result, the pressure of gas and air are always held in a constant ratio, whatever be the variation of either the inlet pressure of gas and air or consumption.

If the mixture of gas and air is rich in gas the flame is lengthened. On the other hand, if the proportions approach six or seven volumes of air to one of gas (according to the quality of the gas), it is quite possible, given silica or any other good catalyzer, to have no flame at all, but nearly surface combustion. Should a good catalyzer be placed at right angles to a stream of well-proportioned mixture, a glowing disk will be observed. On the other hand, if all catalyzers in front of this stream are avoided, the combustion can be spread

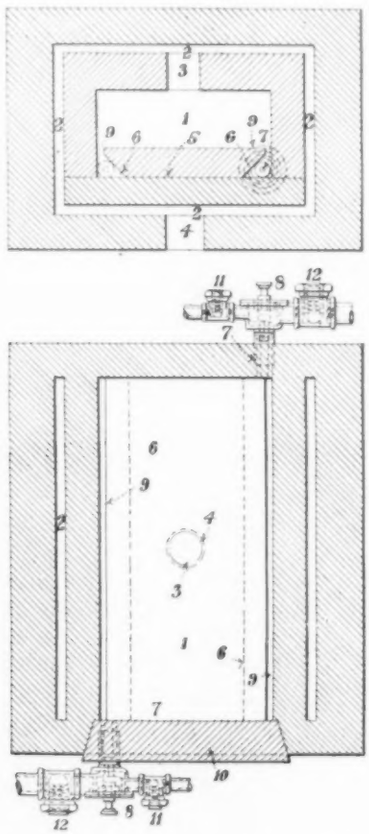


FIG. 10 IONIDES RECTANGULAR BARREL FURNACE

out to a very considerable length. The author has proved by experience that with the ¾-in. injector, or even ½-in., it can be spread out to a length of 3 ft. of almost homogeneous combustion by putting the injector into the channel of firebrick open at the top. This permits even distribution of the heat units in a furnace or blower.

Next, it was found that the hotter the furnace grew, the less was the consumption of gas. This is, to a certain extent, due to expansion of gases by combustion. Assume that the gas mixture enters the furnace at, say, 15 deg. cent. If the temperature of the furnace was 1700 deg., it will have expanded to $1700/(273 + 15)$, or 5¾ times its initial volume.

If the waste gases, instead of passing into a chimney open at the top, are displaced downwardly through a contracted exit of predetermined cross-sectional area, this will cause a

resistance to the flow of incoming gases and provide the elements of the most refined thermostat without any mechanically working parts. It is claimed that by these means the temperature to be maintained can be predetermined by calculation.

The problem of determining the mixture was solved by a simple plan of fitting an ordinary gas cock with a piece of copper tubing bent with an easy bend and enlarged at the further end. Then a piece of india rubber tubing and an incandescent mantle are fed with the mixture, the light indicating the character of the mixture. If the meshes of the mantle are visible, it means an oxidizing mixture. If the mantle is in its most brilliant state, the mixture is very near the neutral point. On the other hand, if any unburned gas is seen to escape from the mantle in the shape of a blue flame, the mixture will be a reducing one. This provides a sensitive indicator.

The actual construction of the furnace is shown in Fig. 10. The operation of this furnace is as follows:

A heating chamber, 1, having a door, 10, at the front, is provided above and below, and, upon the greater portion of its sides, with two jacketing flue spaces, 2. The chamber, 1, communicates by one or two central apertures, 3, with the top flue space, and the heating elements passing through the said aperture pass downwards through the flues, 2, and are finally discharged through the outlet pipe, 4. In the bricks, 5, forming the floor there is provided along each of the two long sides a narrow combustion chamber, 6, into which the nozzle, 7, delivers mixture from a mixture device, 8, provided with gas- and air-adjusting means, 11 and 12. The long combustion chambers, 6, each deliver the products of combustion by a long, narrow slot, 9, into the furnace chamber, 1. The nozzle is positioned at one end of the long combustion chamber, so that the heating elements, due to their travel along the chamber and their upward motion to escape through the slot, 9, enter the furnace chamber, 1, with a diagonal movement parallel to the wall thereof. The gases passing along the wall will tend to turn at the angle when meeting the adjacent wall, and thus a whirling motion of the gases round the walls of the chamber will be created. If the nozzles of the two combustion chambers are arranged at opposite ends of the furnace, as shown, this whirling will be accentuated, the gases being gradually drawn inward across the roof of the furnace chamber on their way to escape at the outlet aperture, shown in the figure at 3.

A half-ton billet-heating furnace has been made, in which the gas consumption was 1.3 cu. ft. per lb. for full forging heat; the scaling was negligible. It is claimed that actual tests (data in original article) show that in brass melting an economy analogous to that afforded in steel forging can be effected. The Vickers Co. applied this system to a barrel-heating furnace, 36 in. by 12 in. by 3 in. inside, which resulted in their coming to an agreement to establish this system throughout their works.

As an indication of the correctness of the principles employed, the author would point out that a light worked by means of a pressure balance feeding a small incandescent mantle will produce 130 to 150 candlepower, with a consumption of under 3 cu. ft. per hour of town gas of standard calorific value; whereas, it can be stated on the authority of Mr. J. G. Clark in *Gas Journal*, May 4, 1915, that the highest-candlepower light obtainable at this pressure by other systems averages 22 candlepower per cu. ft. of gas consumed —variable, of course, owing to the atmospheric burner. (*The Engineer*, October 12, 1917, pp. 320-321, 5 figs., *d*)

EFFECT OF BRICK ARCH ON SMOKE ABATEMENT, J. T. Anthony

The paper refers mainly to locomotive practice, but some of its conclusions may have a bearing also in application to stationary boilers.

The Chicago Smoke Commission made extensive tests with and without the arch and found that the presence of the arch has certain beneficial results.

Tests recently conducted on a Mikado-type locomotive show smoke reductions varying from 50 per cent at low and medium rates of firing to 31 per cent at high rates of firing. The locomotive was hand-fired, using high-volatile Pennsylvania gas coal screened over a 1¼-in. mesh screen. This locomotive had 70 sq. ft. of grate area, a barrel combustion chamber and a 76-in. arch supported on four 3-in. arch tubes.

In these tests the increase in evaporation due to the arch varied from 8½ to 15½ per cent.

As regards the reasons why the arch decreases smoke, the following is to be borne in mind: With the conditions that prevail in the locomotive firebox it is easier to prevent the formation of soot than to burn it when once formed. The precipitation of soot can be prevented by having an excess of the heated air above the fuel bed. Research work done by the U. S. Bureau of Mines indicates that the hydrocarbons from the fuel bed are decomposed when they have traveled but a few inches from the top of the fuel bed, and hence if the precipitation of carbon is to be prevented the air or oxygen must be introduced at the top of the fuel bed and intimately mixed with the issuing hydrocarbons.

The chief function of the brick arch in abating smoke is that by baffling the gas mixture and compelling all the gases to pass through a relatively restricted area above the arch, an intimate mixture of the volatile combustible with the oxygen is insured. Where the arch is provided any excess air coming through this portion of the fire on the front of the grates is heated up, deflected and forced back over the end of the arch where it is mixed with the gaseous combustibles rising from the green coal under the door.

The results obtained with the arch depend, however, materially upon the method of firing. To reduce smoke to a minimum a slight level fire should be carried. With the fuel bed in this condition and a "scatter" type of firing being used, a uniform air supply is obtained throughout the fuel bed, as well as a uniform distillation of the hydrocarbons. (Paper read at the Convention of the Smoke Prevention Association, Columbus, Ohio, September, 1917; abstracted through *Power*, vol. 46, no. 16, October 16, 1917, pp. 540-541, *p*)

Handling and Conveying

POWER PLANT OF THE ST. JOSEPH LEAD COMPANY, E. L. Broome, Mem.Am.Soc.M.E.

Description of a new central plant serving several mining properties of the St. Joseph Lead Company, operating in St. Joseph, Mo. Of particular interest is the system of handling the coal and feedwater.

The coal is received from an elevated track discharging into a 30-ton steel track hopper underneath, by means of an opposed pair of reciprocating trough-shaped grizzlies. The smaller sizes fall into chutes at each side of the crusher and thence are fed directly to the belt. The larger pieces roll over the ends of the grizzlies and fall in the center into the crusher hopper, from which they are delivered on a 20-in. inclined belt conveyor driven from the upper end and provided with a magnetic pulley for the removal of pieces of iron. The belt

conveyor discharges into a circular steel bunker 30 ft. in diameter, lined with 4 in. of reinforced concrete and having a capacity of 400 tons. Under the bunker is an 8-ton weighing hopper provided with an automatic registering scale beam and discharging into duplicate horizontal helical conveyors 12 in. in diameter, extending the full length of the boiler room over the stoker hoppers, the trough being provided with a rack-and-pinion-operated sliding gate over each stoker. This solution of the fuel-supply problem results in a light, well-ventilated boiler room, while the spiral conveyors insure a very homogeneous condition of fuel at the stoker hopper and permit a uniform moistening of the fuel (this latter practice has been adopted to prevent coking and reduce dust).

Water for boiler feed is drawn for the mine and a maximum of softening is insisted upon. The mine water runs about 18 grains per gallon total hardness, equally divided between carbonates of calcium and magnesia. Two complete

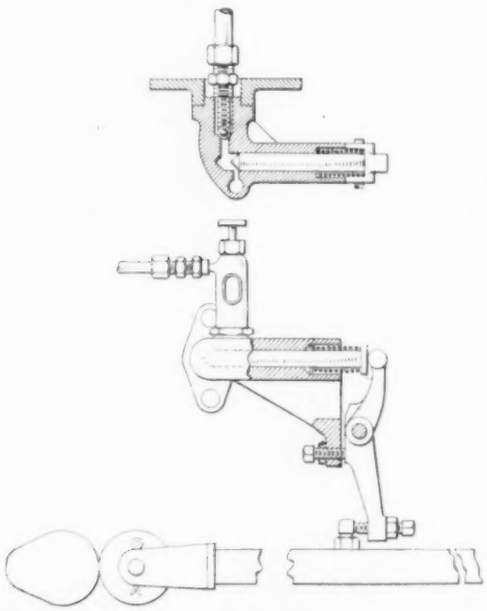


FIG. 11 SPECIAL OIL PUMP FOR LUBRICATING THE CYLINDER OF THE EVINRUDE OIL ENGINE

water-softening treatments have been installed. The lime-soda treatment of the continuous type takes the raw water at 18 grains per gallon hardness and reduces this hardness to five grains per gallon. This water is then passed through a pressure sand filter into a Permutit softening filter, where it is reduced to zero hardness. (*Power*, vol. 46, no. 18, October 30, 1917, pp. 582-585, 6 figs., *d*)

Internal-Combustion Engineering

ALCOHOL AND HYDROCARBONS AS FUELS

In 1916 a committee was appointed by the Minister of Commerce and Industries of France to consider the scope of national resources in fuels for internal-combustion engines. This committee has presented an extensive report from which the following data are abstracted.

In the first place, the report considers alcohol. It points out that in addition to grain alcohol proper enormous amounts of industrial alcohol can be derived from the treatment of waste wood. The method of production of ethyl alcohol consists in the proper treatment of wood shavings or sawdust, from which may be obtained up to 15 per cent of alcohol (which is real ethyl alcohol, and not wood alcohol). In addition, alcohol may be prepared synthetically. In the first place, acetylene is produced from calcium chloride. Next, by an electric arc ethylene is extracted from acetylene, and this, in turn, gives sulfovinic acid, which is used for the production of alcohol.

Acetylene may be used in another way for the production of ethyl alcohol. The acetylene is passed through a solution containing one-thousandth part of bichloride of mercury, which results in the production of acetaldehyde, which latter, after being heated, is converted into alcohol by hydrogenation. The synthetic production of alcohol known in France only as a laboratory process is commercially used in Germany.

In view of the fact that a heavy tax exists on alcohol used for drinking purposes, all industrial alcohol must be denatured. In France a denaturing agent used is methylene containing 25 per cent of acetone and at least 2.5 per cent of pyrogenous impurities.

Among other things, it has been found that denatured 90 per cent alcohol can be used in gasoline engines under the following conditions: increased compression, altered distribution, and the employment of special means for preheating the charge and starting the engine. A more convenient method would have been the use of a mixture of three carbureting fuels in the present gasoline engines.

The use of such a mixture is based on the ability to satisfy certain conditions. In the first place, all these fuels should easily dissolve in each other in all proportions. Now commercial benzol containing 14 per cent of toluene and 1 per cent of xylene is very soluble in 90 per cent alcohol, but it would take 40 volumes of 95 per cent alcohol to dissolve 60 volumes of gasoline. Hence, for industrial purposes, it is necessary to use 95 per cent alcohol, of which 100 volumes dissolve 900 volumes of benzol and 150 volumes of gasoline.

It is very likely, however, that after the war benzol will be used in other industries, such as, for example, the production of dyes. In that case its price would make its use as a fuel prohibitive. In view of this possibility, the employment of ether-ethyl as an auxiliary fuel has been investigated.

The manufacture of ether is very simple, and its price is only seven or eight per cent that of alcohol. The only obstacle that lies in the way of its more extensive use is in the regulations of the French Excise Department. It appears that otherwise a mixture of alcohol, ether and kerosene could be used for both power and lighting purposes.

As regards the power purposes, extensive tests have shown that a mixture of 65 per cent of 95 to 96 per cent alcohol, with 10 per cent of ether and 25 per cent of a hydrocarbon fuel, can be burned perfectly well in an engine. In fact, with this mixture there is no trouble in starting an engine, and the consumption per volume is approximately the same as that of gasoline, at least for light vehicles.

The same fuel for stationary motors and trucks has given a less satisfactory result, the consumption per volume, as compared with gasoline, varying in approximately the inverse ratio of the heat values of the respective fuels. (*L'emploi de l'alcool industriel et des hydrocarbons comme carburants*, P.M., *Le Génèe Civil*, vol. 71, no. 14, October 6, 1917, pp. 225-228, 2 figs., *gp*)

EVINRUDE OIL ENGINE

In THE JOURNAL were given data on the Hvid cycle of oil engines. Essentially it is a high-compression cycle similar to that used in the Diesel engine, but with a different system of injecting the fuel. In the cylinder there is a cup with two

tiny openings at the side. The compression forces air through these openings so that the air in the cup is highly heated. This high temperature volatilizes a small portion of low-boiling fuel which is present in every oil and causes a sort of explosion in the cup, driving the fuel out in a spray.

The present engine is built by the Evinrude Motor Co. of Milwaukee, Wis. At present only 1½-hp. and 3-hp. sizes are being built, but it is announced larger sizes will be added later.

The 1½-hp. engine has a 3¼-in. bore and 5-in. stroke and is designed to operate at 600 r.p.m. The fuel tank is passed between the flywheels just over the crankcase, and fuel is supplied to the fuel cup by gravity.

The cylinder is lubricated by a special oil pump shown in Fig. 11. Oil from the lubricating-oil tank, which forms a small compartment of the fuel tank, flows to the oil pump through a side feed, and is then forced by the plunger through the cylinder wall to the surface of the piston. The pump is timed to operate when the piston is in its extreme outward position during the exhaust stroke. In this manner the oil is regularly and at the proper time fed in the cycle. (*The Gas Engine*, vol. 19, no. 11, November 1917, pp. 536-537, 6 figs., *d*)

TABLE 6 VALUES OF k

S.W.G. No.	Round Wire	Square Wire
7/0	93,750	99,150
6/0	69,530	73,550
5/0	52,240	55,260
4/0	38,400	40,610
3/0	28,720	30,380
2/0	22,000	23,270
0	16,530	17,490
1	12,150	12,850
2	8,704	9,206
3	6,050	6,400
4	4,345	4,596
5	3,030	3,205
6	2,040	2,158
7	1,440	1,524
8	983.1	1,040
9	645	682.3
10	402.6	423.8
11	271.6	287.3
12	175.5	185.7
13	107.5	113.7
14	61.44	65
15	40 31	42.64
16	25 16	26.62
17	14.75	14.61
18	7.962	8.422
19	3.840	4.061
20	2.518	2.664
21	1.573	1.663
22	0.9225	0.9757
23	0.4980	0.5267
24	0.3510	0.3713
25	0.2400	0.2639

TABLE 7 CUBES AND FOURTH POWERS OF GAGES

S.W.G. No.	Equivalents		Cube	4th Power
	Approx. in.	Dec. in.		
7/0	1/2	.500	.12500	.06250
6/0	15/32+	.464	.09990	.04635
5/0	7/16−	.432	.08062	.03483
4/0	13/32−	.400	.06400	.02560
3/0	3/8 −	.372	.05148	.01915
2/0	11/32+	.348	.04214	.01467
0	21/64−	.324	.03401	.01102
1	19/64+	.300	.02700	.008,100
2	9/32−	.276	.02102	.005,803
3	1/4 +	.252	.01600	.004,033
4	15/64−	.232	.01249	.002,897
5	7/32−	.212	.009,528	.002,020
6	3/16+	.192	.007,078	.001,359
7	11/64+	.176	.005,452	.000,959,5
8	5/32+	.160	.004,096	.000,655,4
9	9/64+	.144	.002,986	.000,430.0
10	1/8 +	.128	.002,097	.000,286,4
11	7/64+	.116	.001,561	.000,181,1
12	7/64−	.104	.001,125	.000,117,0
13	3/32−	.092	.000,778,7	.000,071,64
14	5/64+	.080	.000,512,0	.000,040,96
15	5/64−	.072	.000,373,2	.000,026,87
16	1/16+	.064	.000,262,1	.000,016,78
17	1/16−	.056	.000,175,6	.000,009,834
18	3/64+	.048	.000,110,6	.000,005,308
19	3/64−	.040	.000,064,00	.000,002,560
20	1/32+	.036	.000,046,66	.000,001,679
21	1/32	.032	.000,032,77	.000,001,049
22	1/36	.028	.000,021,95	.000,000,615
23	1/42	.024	.000,013,82	.000,000,332
24	1/45	.022	.000,010,65	.000,000,234
25	1/50	.020	.000,008,000	.000,000,160

Mechanics

THE DESIGN OF COIL SPRINGS, W. Ferrier Brown

In these notes it is the intention to simplify and accelerate the calculation of coiled springs as far as is practicable by embodying constants, which are supplied in tabular form.

The formulæ given in the various engineering pocketbooks for coil springs are practically alike, and differ mainly in the arrangement of the formulæ. The selection for these notes is that given in Lineham's Mechanical Engineering, as this has been proved to give accurate results.

The symbols used in this formula are:

D = diameter of wire in inches
Δ = total deflection in inches
W = total load in lb.
w = load per inch deflection in lb.
n = number of free coils
d = diameter of coil pitch circle in inches
c = 12,000,000 lb. for steel.

For round wire:

$$\Delta = \frac{8Wnd^3}{cD^4} \quad \ldots\ldots [1]$$

$$\text{and } w = \frac{cD^4}{8nd^3} \quad \ldots\ldots [2]$$

For square wire:

$$\Delta = \frac{60.5\,Wnd^3}{8cD^4} \quad \ldots\ldots [3]$$

$$\text{and } w = \frac{8cD^4}{60.5\,nd^3} \quad \ldots\ldots [4]$$

Equations [2] and [4] form the basis, and from these the total deflection can easily be calculated thus:

$$\Delta = \frac{W}{w} \quad \ldots\ldots [5]$$

In addition to deflection, it is necessary to know the gage or diameter of wire of which to make the spring to take a certain load.

In Adams's Engineers' Handbook, the following formulæ are given:

Safe load (W) for springs, such as valve springs

$$= \frac{1{,}750\,D^3}{d} \quad \ldots\ldots [6]$$

This can be transposed to read:

$$D = \sqrt[3]{\frac{11{,}750}{Wd}} \text{ for round section} \ldots [7]$$

For square-section wire use the relation:

$$D = \sqrt[3]{\frac{Wd}{13{,}000}} \quad \ldots\ldots [8]$$

Safe load (W) for springs that can be worked almost to the elastic limit

$$= \frac{27{,}400\ D^3}{d} \quad \ldots\ldots [9]$$

$$\text{or } D = \sqrt[3]{\frac{Wd}{27{,}400}} \text{ for round wire.. [10]}$$

$$\text{and } D = \sqrt{\frac{Wd}{30{,}000}} \text{ for square wire. [11]}$$

On examination of Equations [2] and [4] it will be seen that the term cD^4 is a constant factor, and has the values $cD^4/8$ in Equation [2] and $8cD^4/60.5$ in Equation [4]

Let the constants be represented by k. Equations [2] and [4] will then read:

$$w = \frac{k}{nd^4} \quad \ldots\ldots [12]$$

The value of k will be selected from the column for round or square wire, as the case may be, in Table 6.

In this table values of k for round and square wire have been calculated over a range of from 7/0 S.W.G. to 25 S.W.G. This range covers the average run of automobile work. Special cases can always be calculated from the equations in their original form, i.e., Equations [2] and [4].

Table 7 gives the cubes and the fourth powers of the various gages. These are used in conjunction with Equations [2], [4], [6] and [9].

(*The Automobile Engineer*, vol. 7, no. 107, October, 1917, p. 286)

Refrigeration

CORROSION OF BRINE PIPE, F. N. Speller

A report of a recent experience with corrosion of brine coils in an ice skating rink in Pittsburgh, Pa.

The pipe used was 1¼-in. double-length butt-welded standard-type steel pipe. It was found that after a comparatively short period of service the pipe was badly pitted.

The pipe was first used in the rink, but during the following summer was stored on a river barge. An analysis of the rust and scale from the inside of this pipe indicated in some cases a considerable amount of calcium chloride.

It appears that the pitting may have been due to two causes. First, heavy mill scale which is incidental to the practice of making butt-welded pipe; but while the cinder is present in all pipe and is an accelerator of corrosion on account of its electronegative character compared with iron, corrosion can only occur when moisture and oxygen are present together. Here is where the presence of calcium chloride in the scale comes in. Pure calcium chloride with pure water is not very corrosive, especially at low temperatures out of contact with the air, but when present even in small quantities on the inside of a moist pipe it will retain this moisture on account of its hygroscopic character. It appears therefore that the pipe was subjected to a combination of elements, such as mill scale, calcium chloride, moisture, oxygen and temperature above normal during the summer months, all of which tend to accelerate corrosion.

From data given in the article it appears that the fact that the pipe was steel had comparatively little to do with the result, which was due to improper conditions of storage of the pipe. (*A. S. R. E. Journal*, vol. 4, no. 2, September, 1917, pp. 220-224, 1 fig., *p*)

Railroad Engineering

SANTA FE TYPE LOCOMOTIVES FOR THE UNION PACIFIC SYSTEM

Description of locomotives now being built by The Baldwin Locomotive Company for the Union Pacific System. The locomotives are of a heavy and powerful design, so arranged that either coal or oil can be used.

An interesting feature is the trailing truck (Delta), built with a massive steel casting, which serves the triple purpose of a frame, radius bar and equalizer. The truck is equalized with the two rear pairs of drivers. The equalization is through a central, vertical heart-shaped link, which is suspended from a transverse beam hung from the rear driving springs. This link acts not only as the equalizer connection, but also as the rear-truck radius-bar pin. It is circular in section at its lower end, and is guided in the frame cradle casting. The bearing between the equalizer frame of the truck and the locomotive frame is made with a spherical surface to provide sufficient flexibility. (*Railway Review*, vol. 61, no. 18, Nov. 3, 1917, pp. 541-542, 2 figs., *d*)

AUTOMATIC STRAIGHT AIR-BRAKE SYSTEM

Description of a new air-brake system recently announced by the Automatic Straight Air-Brake Company for freight and passenger equipment.

This brake system provides a quick-action passenger brake, one brake cylinder being used for a service application and two brake cylinders for an emergency application of the brake. As the triple valve is capable for compensating for varying volumes in brake cylinders, a two-brake cylinder can be added to existing freight equipment for empty and load braking.

Due to its construction and operation this brake has the characteristics of a straight air brake, and, at the same time, is automatically operated. The straight air features are obtained through the fact that with every application of the brakes air is exhausted from the brake pipe under each car.

Design of the triple valve is such that, when fully charged, the pressure in the brake pipe, acting on the underside of the diaphragm, balances the pressure in the auxiliary reservoir acting on the upper side. The reduction in brake-pipe pressure causes the auxiliary-reservoir pressure to force the diaphragm downwards, admitting air to the brake cylinder from the brake pipe and service reservoir. The air in the brake cylinder acts on a second diaphragm which is connected to the first and which is of half its area. The pressure in the auxiliary reservoir remains unbalanced, forcing the diaphragm down until the force exerted by the brake-pipe pressure on the underside of this diaphragm, plus force exerted by the air in the brake cylinder on its diaphragm exceeds it. The diaphragm will then be raised and the supply of air to the brake cylinder cut off.

Hence, the brake-cylinder pressure bears a direct relation to the brake-pipe reduction and is not affected by the brake-piston travel or brake-cylinder leakage. By regulating the brake-pipe pressure any brake-cylinder pressure may be obtained. Besides, each triple valve is provided with means for making a graduated or quick release.

One of the features of this brake is that service applications can be varied at the will of the engineman by his regulation

of the brake-pipe pressure without the necessity of releasing the brakes before a reapplication when operating with the graduated release.

The article describes in detail the operation of the brake, and gives data of exhibition tests made by the company on a 100-car test rack. (*Railway Age Gazette*, vol. 63, no. 16, October 19, 1917, pp. 697-700, 4 figs., *d*)

Thermodynamics

PERFORMANCE AND DESIGN OF SURFACE FEEDWATER HEATERS, M. C. Stuart, Mem.Am.Soc.M.E.

The writer develops his theory of heat transmission from the fundamental law that heat transmission is proportional to temperature difference.

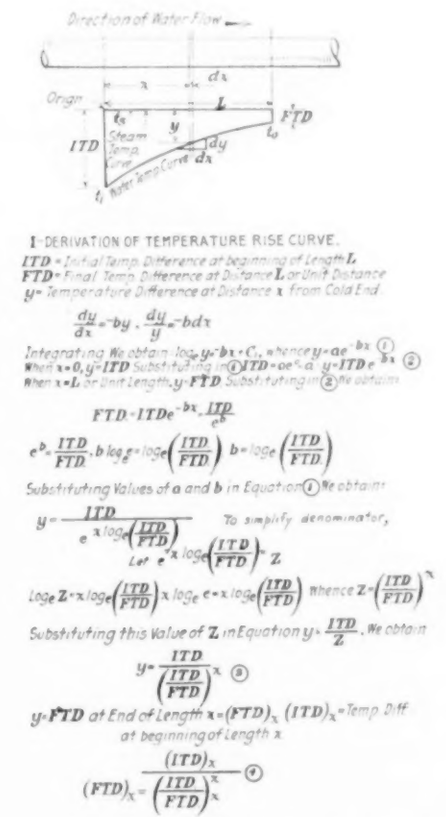

Direction of Water Flow
Origin
ITD
Steam Temp. Curve
Water Temp. Curve
FTD
I-DERIVATION OF TEMPERATURE RISE CURVE.
ITD = Initial Temp. Difference at beginning of Length L
FTD = Final Temp. Difference at Distance L or Unit Distance
y = Temperature Difference at Distance x from Cold End
Integrating We obtain
When x = 0, y = ITD
When x = L or Unit Length, y = FTD
Substituting Values of a and b in Equation (1) We obtain
To simplify denominator,
Let
Substituting this Value of Z in Equation
We obtain
y = FTD at End of Length x = (FTD)x (ITD)x = Temp. Diff at beginning of Length x

FIG. 12 DERIVATION OF CURVE OF TEMPERATURE RISE

This assumption in the case of a tube with steam on one side and water on the other side of the metal wall may be expressed by the differential equation $dy/dx = -by$, which after integration, reduces to the equation of the temperature-rise curve (1), Fig. 12. After determination of the values of the constants a and b, in terms of temperature, this equation is reduced to the simple forms (3) and (4), Fig. 12.

From this the writer proceeds to the determination of, first, the mean temperature difference between water and steam, and then of heat-transfer rate from steam to water, Fig. 13, the mean temperature difference being defined as the average distance between the curves of steam temperature and water temperature.

Experimentally, the validity of the theoretical relations between temperatures and tube lengths may be best demonstrated on multi-pass feedwater heaters, in which temperature readings are obtained at the end of each pass because such tests give simultaneous data for performance of identical sections of a heater with identical conditions of steam pressure and water flow.

A recent test of a four-pass heater, made at the U. S. Naval Engineering Experiment Station, Annapolis, Md., gave the following data for a run in which the water velocity was 5.14 ft. per sec. and the steam temperature was 227.2 deg. fahr.

	Water Temperatures, Deg. Fahr.	
	Inlet	Outlet
First pass	85.6	133.4
Second pass	133.4	165.8
Third pass	165.8	186.7
Fourth pass	186.7	201.3

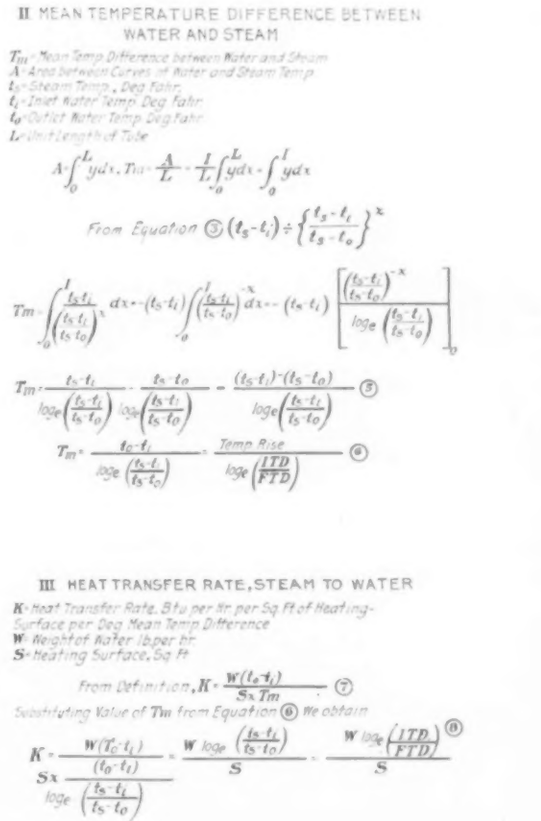

II MEAN TEMPERATURE DIFFERENCE BETWEEN WATER AND STEAM
Tm = Mean Temp. Difference between Water and Steam
A = Area between Curves in Water and Steam Temp.
ts = Steam Temp., Deg. Fahr.
ti = Inlet Water Temp. Deg. Fahr.
to = Outlet Water Temp. Deg. Fahr.
L = Unit Length of Tube
From Equation (5)
III HEAT TRANSFER RATE, STEAM TO WATER
K = Heat Transfer Rate, Btu per Hr. per Sq. Ft. of Heating-Surface per Deg. Mean Temp. Difference
W = Weight of Water, lb. per hr.
S = Heating Surface, Sq. Ft.
From Definition,
Substituting Value of Tm from Equation (6) We obtain

FIG. 13 DERIVATION OF CURVE OF MEAN TEMPERATURE DIFFERENCE AND HEAT-TRANSFER COEFFICIENT

These temperatures are plotted in Fig. 14 in what may be called a temperature diagram. The abscissæ are the inlet temperatures of the several passes and the ordinates are the corresponding outlet temperatures. A base line is drawn diagonally across the diagram through points of equal temperature, and the line of inlet temperature vs. outlet temperature, which is drawn through the plotted points, is extended to meet the base line at a point corresponding to the steam temperature, this line intersecting the base line at the steam temperature, because if water enters any pass at the temperature of the steam there will, of course, be no temperature rise and the temperatures of inlet water, outlet water, and steam will be equal.

In a multi-pass heater the outlet temperature of one pass becomes the inlet temperature of the next pass, as shown graphically by the "stairway" formed between the tempera-

ture line and the base line, both indicated in the figure.

As regards the relation between the temperature diagram and the theory, as previously developed, the following is pointed out. If the temperature line of the diagram is straight and intersects the base line at the steam temperature, it is evident that the ratio of initial temperature difference to final temperature difference is constant. From formula [8] for the value of heat-transfer coefficients, it is seen that the constant values of W and S, as existing in the several passes of the multi-pass heater K, will be constant if the ratio (I. T. D.) to (F. T. D.) is constant. Inasmuch as the temperature diagram satisfies this condition, this confirms the theory that the

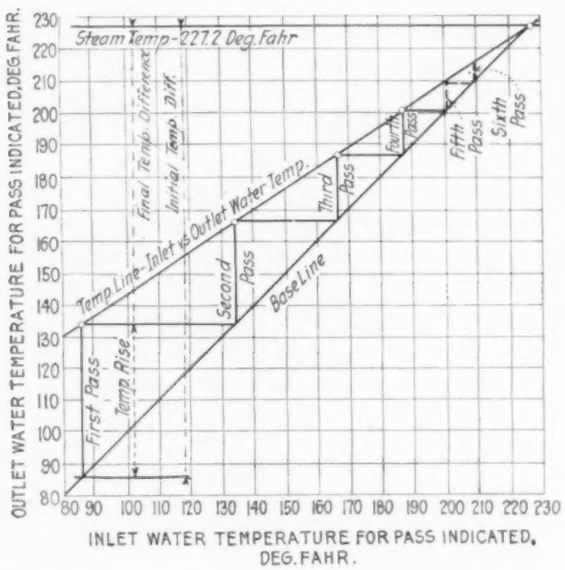


FIG. 14 TEMPERATURE DIAGRAM FOR FOUR-PASS FEEDWATER HEATER BY SEPARATE PASSES

heat-transfer coefficient is independent of temperature and depends only on the ratio of initial to final temperature difference.

To extend the method to another field, there is shown in Fig. 15 a temperature diagram plotted from the classic test of Mr. G. A. Orrok, Mem.Am.Soc.M.E., on The Transmission of Heat in Surface Condensation, published in the Transactions of The American Society of Mechanical Engineers, 1910, p. 1139. The test was made upon a single condenser tube through which water flowed, and which was surrounded by steam. The line FD was plotted from runs in which the steam temperatures were constant at 115 deg., and the inlet-water temperatures varied from 53 to 110 deg. fahr. The line BC was plotted from runs in which the water temperatures were constant at 50 deg. and the steam temperatures were varied from 115 to 187 deg. fahr. Space will not be taken here to analyze these results, but it may be stated that the temperature line BC is straight and the line DF is nearly straight, and that from the equation for heat-transfer factor $K = \frac{W}{S} \log_e \frac{\text{I. T. D.}}{\text{F. T. D.}}$ it is seen that a straight line on the temperature diagram corresponds to a constant value of K. The exact value of K along the temperature line may be determined from the ratio of $\frac{\text{I. T. D.}}{\text{F. T. D.}}$ as found from the temperature diagram, and the known values of W and S. The effect of tube length on water temperature may be shown by forming a stairway between the temperature line and the base line.

The analytical relation between tube length and temperature rise along the tube was derived in Fig. 12 and is represented by formula [4]. In the present paper the writer gives three graphical methods of showing the relation between tube length and water temperature.

A logarithmic plot of heat-transfer factors and friction drop is given in the original article where the values of heat-transfer coefficients are plotted against water velocity on logarithmic coördinates. The relation between K and the velocity in feet per second may be expressed by the equation $K = 339\ V^{.60}$, which form agrees with the results found by Orrok and others. The value of K may be composed from the value of the ratio $\frac{\text{I. T. D.}}{\text{F. T. D.}}$ as given by the temperature diagram and a temperature diagram for any velocity may be drawn by solving for the value of $\frac{\text{I. T. D.}}{\text{F. T. D.}}$ from the value of K for that velocity.

On the whole, the writer comes to the final conclusion that the design of a feedwater heater or other form of heat-transfer apparatus consists of determining the proper balance among the factors: tube length, number of tubes, velocity, total sur-

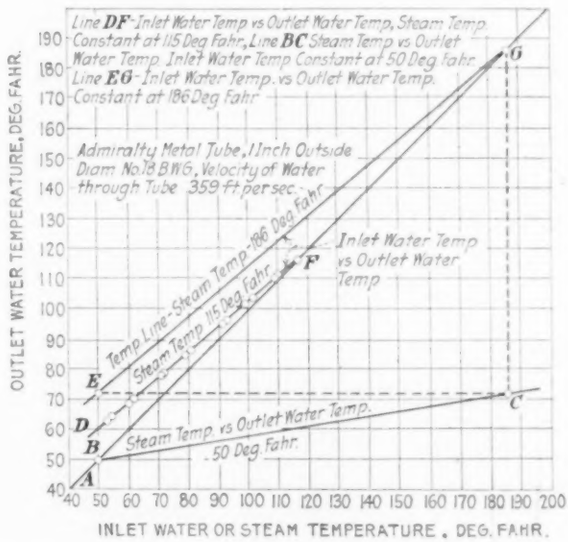

Line DF-Inlet Water Temp vs Outlet Water Temp, Steam Temp. Constant at 115 Deg. Fahr., Line BC Steam Temp vs Outlet Water Temp. Inlet Water Temp Constant at 50 Deg. Fahr. Line EG-Inlet Water Temp. vs Outlet Water Temp. Constant at 186 Deg. Fahr.
Admiralty Metal Tube, 1 Inch Outside Diam. No. 18 B.W.G., Velocity of Water through Tube .359 ft. per sec.
Temp. Line-Steam Temp. 186 Deg. Fahr.
Steam Temp. 115 Deg. Fahr.
Inlet Water Temp vs Outlet Water Temp
Steam Temp. vs Outlet Water Temp. 50 Deg. Fahr.
OUTLET WATER TEMPERATURE, DEG. FAHR.
INLET WATER OR STEAM TEMPERATURE, DEG. FAHR.

FIG. 15 TEMPERATURE DIAGRAM FROM TESTS OF CONDENSER TUBE BY GEO. A. ORROK

face, friction drop and temperature rise. An analytical method of design for feedwater heaters is likewise indicated. This method essentially is based upon the relation between heat-transfer coefficients and velocity. $K = aV^n \ldots$ [1], and the relation between friction loss and velocity $H = bLV^m \ldots$ [3]. By combining these two empirical equations with the theoretical equation for heat-transfer coëfficient, equation [2], there finally results equation

$$V^{1-n+m} = \frac{aC_2H}{bc_1 \log_e \left(\frac{t_2 - t_1}{t_2 - t_0}\right)}$$

(*Journal of the American Society of Naval Engineers*, vol. 29, no. 3, August 1917, pp. 503-524, 16 figs., *tA*)

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LIBRARY NOTES

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PERSONALS

IN these columns are inserted items concerning members of the Society and their professional activities. Members are always interested in the doings of their fellow-members, and the Society welcomes notes from members and concerning members for insertion in this section. All communications of personal notes should be addressed to the Secretary, and items should be received by December 17 in order to appear in the January issue.

CHANGES OF POSITION

SAKICHI ISHIMURA, formerly draftsman with Cornwall and Raymo, Inc., New York, has become affiliated with Nippon Deuchi and Company, of Kyoto, Japan, as engineer.

LLOYD LOGAN, formerly assistant mechanical engineer, Wescott and Mapes, Inc., New Haven, Conn., has become affiliated with the Union Sulphur Company, Sulphur Mine, La.

CHARLES J. SIMEON has accepted a position with the Curtiss Aeroplane Company, Buffalo, N. Y. He was formerly works manager of the Reed-Prentice Company, Worcester, Mass.

JOHN P. ILSLEY, formerly associated with the Niles-Bement-Pond Company, New York, has assumed the position of general manager of the Becker Milling Machine Company, Hyde Park, Mass.

HOWARD G. BENEDICT, works manager of the Aeromarine Plane and Motor Company, Keyport, N. J., has become affiliated with The Glenn L. Martin Company, Cleveland, Ohio, in a similar capacity.

WILLIAM S. LUCEY has become affiliated with the Hammermill Paper Company, Erie, Pa. He was until recently connected with the Eastman Kodak Company, Rochester, N. Y., in the capacity of mechanical engineer.

CHARLES F. MACGILL, formerly efficiency engineer with the Remington Arms and Ammunition Company, Bridgeport, Conn., has joined the engineering department of the Bullock Engineering Works, Inc., Bridgeport, Conn.

GEORGE F. NORDENHOLT, until recently chief inspector of the Harrisburg Pipe and Pipe Bending Company, Harrisburg, Pa., has assumed the duties of inspector of the Budd Manufacturing Company, Philadelphia, Pa.

H. P. AHRNKE, until recently western representative of the Dairy Machinery and Construction Company, Inc., Chicago, Ill., has become identified with the Davis-Watkins Dairymen's Manufacturing Company, Chicago, Ill.

E. L. C. CLARK, until recently connected with the New England Westinghouse Company, Springfield, Mass., has accepted the position of works manager of the Tractor Branch of the Moline Plow Company, Rock Island, Ill.

ANTHONY KENNEDY, formerly vice-president and general manager of the L. H. Miller Safe and Iron Works, Baltimore, Md., has assumed the duties of vice-president of The Hollar Company, bank vault engineers of Philadelphia, Pa.

ASA J. NEFF has terminated his relations with the American Public Service Company, Abilene, Tex., as efficiency engineer, to accept a similar position with the General Engineering and Management Corporation, of New York.

ROY S. KING has accepted the position of professor of experimental engineering at the Georgia School of Technology, Atlanta, Ga. He was formerly assistant professor of mechanical engineering at the University of Arizona, Tucson, Ariz.

LESTER G. CATTERMOLE, formerly in the employ of the Hannahs Manufacturing Company, Kenosha, Wis., has become connected with the Cooley and Martin Company, Chicago, Ill., in the capacity of efficiency engineer, specializing on woodworking.

CADWALLADER EVANS, JR., is no longer connected with The Delaware and Hudson Company, Scranton, Pa., as general superintendent of the coal department, but is connected with the International Salt Company, with headquarters at Retsoff, N. Y.

GEORGE S. BLANKENHORN has become associated with the American International Shipbuilding Corporation, Philadelphia, Pa., as assistant to the manager of machinery fabrication. He was formerly connected with the consulting engineering department of the Allis-Chalmers Manufacturing Company, West Allis, Wis.

FREDERICK W. LUCHT, JR., formerly on the engineering staff of The Denver Engineering Works Company, Denver, Colo., has become affiliated with the tool design department of the Packard Motor Car Company, of Detroit, Mich., in connection with Government work on the Liberty motor.

H. P. MEREDITH, formerly master mechanic of the Pennsylvania Railroad at Baltimore, Md., Sunbury, Pa., and Wilmington, Del., respectively, has become affiliated with the E. I. DuPont de Nemours and Company, of Wilmington, Del., as engineer in charge of mechanical maintenance, shop methods and efficiency.

HUBERT C. VERHEY has resigned his position as chief designing engineer for the marine Diesel engine department of the Busch-Sulzer Brothers Diesel Engine Company, of St. Louis, Mo., last April, in order to enter the consulting engineering field on Diesel engines, and has now entered the service of the Government in the capacity of chief draftsman of the Emergency Fleet Corporation, Washington, D. C., where he is slated eventually to take charge of Diesel-engine work.

ANNOUNCEMENTS

RUDOLPH H. FOX has accepted a commission of First Lieutenant in the Ordnance Officers' Reserve Corps.

HAROLD K. BEACH has joined the staff of the Cleveland Brass and Copper Company, as mechanical superintendent.

HERBERT H. KESSLER has received a commission as First Lieutenant, Ordnance Section of the Officers' Reserve Corps.

ERNEST R. KENNER has become associated with the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

WILLIAM E. DOLL has been awarded a commission in the United States Army, 35th Engineers, reporting to Camp Grant, Rockford, Ill.

J. E. MACARTHUR, formerly superintendent at the Toronto, Ont., Canada plant of the Russell Motor Car Company, is now located at the Buffalo, N. Y., office of the same company.

GEORGE E. MERRYWEATHER, president of the Motch and Merryweather Machinery Company, Cleveland, O., has been named to take charge of the machine tool section of the War Industries Board.

WINTHROP G. HALL, superintendent of the Spencer Wire Company, Worcester, Mass., has been granted a 10-weeks leave of absence to enter Y. M. C. A. work at Camp Devens, Ayer, Mass.

HENRY C. ARMSTRONG, formerly metallurgical expert, United States Navy, has received a commission in the Ordnance Department of the Army as Captain in the Reserve Corps, and will be ordered to duty shortly.

W. C. BRIGGS, for the past ten years associated with W. A. Battey of the New York office of the Shepard Electric Crane and Hoist Company, in the capacity of sales engineer, has been made district manager of the company.

JOHN HUNTER, chief engineer for the Union Electric Light and Power Company, St. Louis, Mo., has been appointed by the U. S. Government to aid in directing the construction of the American marine fleet, with special charge of shipbuilding operations on the Passaic River in New Jersey.

R. K. HOLLAND, GEORGE E. ACKERMAN and H. K. HOLLAND, formerly associated with Gardner S. Williams, consulting engineer of Ann Arbor, Mich., have opened offices at Ann Arbor, Mich., and Chicago, Ill., under the firm name of Holland, Ackerman and Holland, consulting engineers.

WALTER C. ALLEN, president of the Yale and Towne Manufacturing Company, was granted leave of absence to enable him to respond to the call of the United States Government for service in France. Mr. Allen expects to be commissioned as a Major in the Signal Corps, and to leave soon for France, to take up the duties assigned to him.

F. W. HARDING, consulting engineer of the Canadian Consolidated Rubber Company of Montreal, Que., Canada, has in addition to his other duties taken direct charge of the Rubber Machinery Shops as manager. The Rubber Machinery Shops are owned by the Canadian Consolidated Rubber Company.

HARRY L. HORNING, vice-president and general manager of the Waukesha Motor Company, Waukesha, Wis., and chairman of the motor products section of the War Industries Board, was the guest of honor at the weekly luncheon of the City Club of Milwaukee, on November 3, and discussed the remarkable achievement of American automotive engineers in producing the new military truck in record-breaking time.

THE NEW BOOKS

ALL books received by The Journal will be listed under this heading, generally accompanied by brief descriptive notes. Works of special importance to mechanical engineers will be commented on at length by members and others peculiarly qualified by reason of their experience and training.

Unified Accounting Methods for Industrials. By Clinton E. Woods, author of Woods' Reports, Practical Cost Accounting, Etc. The Ronald Press Co., New York, 1917. Cloth, 5¾x8½ in., 484 pp., 95 forms. $5.

The book opens with a review of the functions and duties of the new profession of industrial engineering, together with a clear statement of the general principles involved and the things to be accomplished.

The author states that the profession of industrial engineering has not as yet received the recognition required to clothe it with the dignity of a collegiate degree, as in other branches of engineering. This, I believe, is fortunate, for rather than extend the subdivisions of the only two logical divisions of engineering, namely, civil and military, the colleges would do well to abolish some of the divisions now recognized by collegiate degrees.

Attention is called to the great number of manufacturing concerns which are doing such a variety of work that they do not know where they stand. Their cost systems do not show on which articles they are really making or losing money —their only idea of distributing operating expense being by a lump sum prorated over the entire product.

The author advocates the departmental distribution of expense, and one would gather from his book that he would undoubtedly extend this to the more accurate method of distributing departmentally on the machine-hour basis.

The results obtained from standardization of equipment and labor methods are well covered, as are all the broader applications of industrial engineering.

The chapter on Analyzing an Industrial Manager's Monthly Balance Sheet will be of interest to all managers who are desirous of getting at the real facts regarding the businesses they manage. The forms shown illustrate the method used, and, of course, can be varied to suit any business. This fact should always be remembered in criticising forms. Forms are simply the tools used to collect information or to perform certain functions. No matter how excellent forms and blanks may be, they of themselves will not run a business.

The subject of General Stores is carefully described, and in this connection it is stated that "No departments in any manufacturing business contribute more to its health or wealth than do the departments of storekeeping." This is most true, for if a manufacturing concern has not absolute control of its stores it cannot do much along the line of industrial engineering. A visit through the factories of this country will show any experienced engineer how little this fact is recognized even at this late date, futile attempts at planning and at time and motion study being made by many people without even a thought to the matter of stores and the control of materials.

The author holds that the Stores Department should come under the Purchasing Department. This, I believe, is wrong from an organization point of view.

He also advises that "The price to be used for any costing or inventory purposes should always be that of the last purchase from any regular source of supply." This is entirely unnecessary if stores records are kept on a unit plan and each delivery of a particular material is kept separate, as is done by many up-to-date factories. Costing and inventorying can then be made on a basis of what was paid for material, not at the last cost.

While the methods of storekeeping described are well thought out, I believe that they are more complicated than there is need for, and they do not represent the latest thought on the subject. The chapters on Handling of Production Schedules are subject to this same criticism of complexity.

In Chapter X is noticed the expression "non-productive labor," which is the bugaboo of so many manufacturers. I think that all industrial engineers should refrain from using the expressions "productive" and "non-productive" labor, which are borrowed from the economist and have no place in modern manufacturing business. Much better is it if we substitute the more accurate terms "direct" and "indirect" labor. In a well-run concern there will be no non-productive labor, but there may be indirect labor. It should, I believe, be one of the duties of engineers to banish this misleading expression "non-productive labor."

Under Employment and Handling of Labor, the author advocates the paying of employees four times a month instead of once a week. The reason for this is that it saves the making out of one entire payroll per month, and the splitting of another, which is required by the weekly method. This method will undoubtedly save a little clerical expense but will probably not be acceptable to the employees. Workmen figure by the week, their rent, etc., being as a rule due at such periods, and they like to know definitely the day on which they are to be paid. To be paid on Monday one week and Tuesday the next, would, I believe, be an excellent method of starting labor difficulties. If the time cards are on a unit scheme and the payroll summed daily, the weekly pay and monthly total are easily secured with little clerical work.

It is unfortunate for business in general, and the manufacturer in particular, that our year is not made up of thirteen months of four weeks each, as this would have numerous advantages for purposes of comparison. Perhaps as the world advances we may yet come to this.

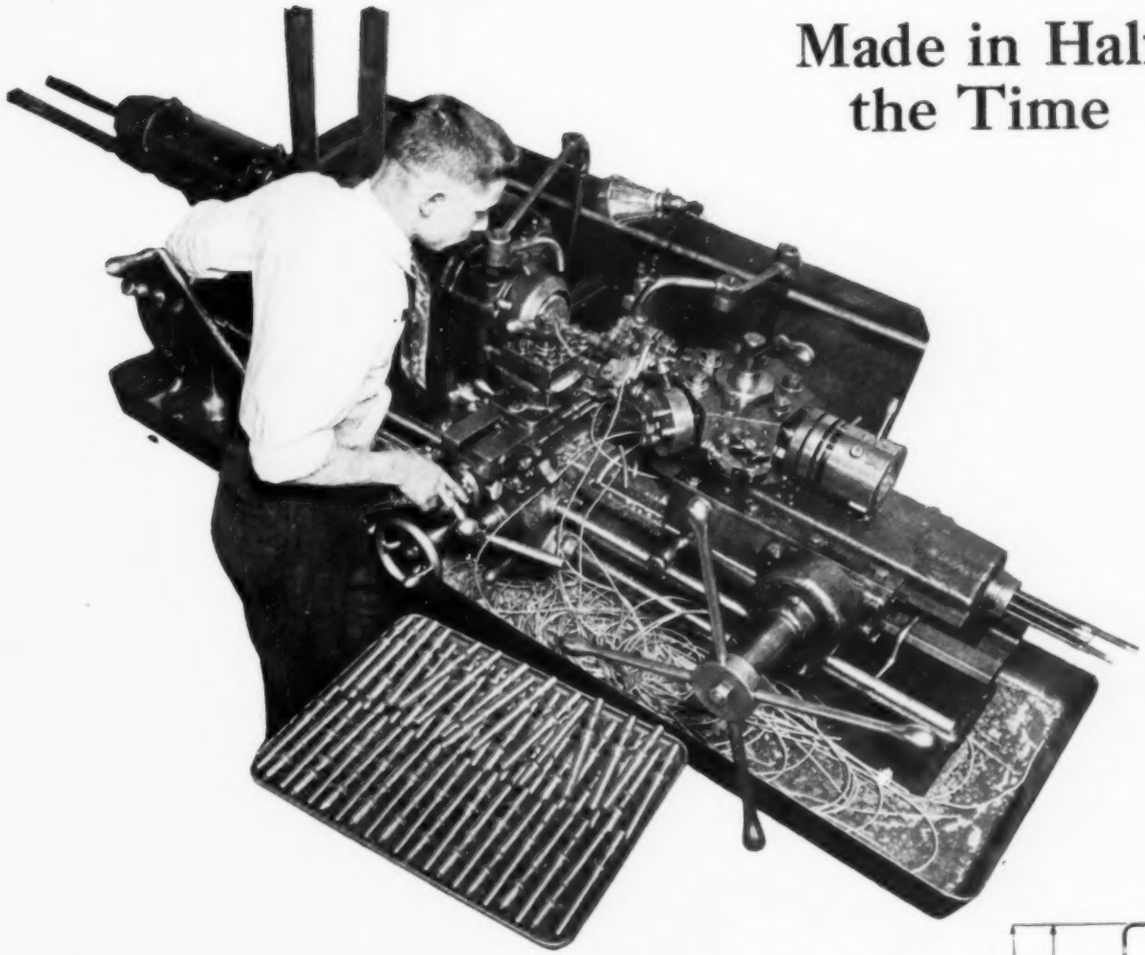
In Chapter XII the matter of organization is dealt with, as well as distribution of labor, material and expense. These are about the most important matters that the industrial engineer has to consider, and might easily take up a book in themselves. The methods illustrated are interesting and instructive.

The remainder of the book is devoted to accounting methods and principles, which are well handled.

While many of the details might not be agreed to by all industrial engineers, the work nevertheless presents a clear outline of the matter and forms a valuable addition to the literature of the subject. It would be well for many manufacturers who have been troubled during the past few years by the fact that they were not showing the profits they should, or were even encountering considerable losses due to antiquated methods of running their plants, to "read, mark and inwardly digest" Mr. Woods's latest publication.

GEORGE M. FORREST.

Made in Half the Time



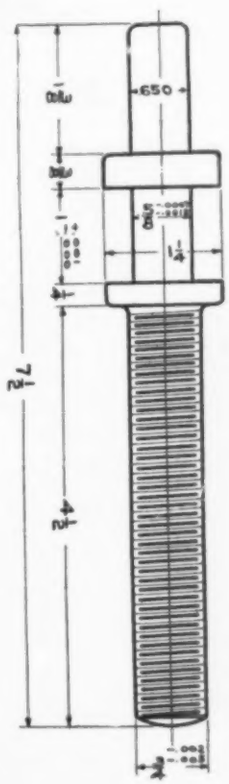
It takes but 5½ minutes—about half the time of the ordinary screw machine—to complete this carbon steel screw on the

No. 4 Universal Turret Screw Machine

Like the Universal Hollow-Hexagon Turret Lathes, this machine takes two cuts at one time, because the carriage has a power operated feed shaft, with eight feeds in either direction, independent of the hexagon turret.

In this example, while the threaded end is being turned and threaded by the hexagon turret, the opposite end is formed and turned by the square turret on the carriage.

Ask us to show how this machine could save time on your work. Send blue-prints with rough and finished samples.



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TURRET LATHES—TURRET SCREW MACHINES—
BRASS WORKING MACHINE TOOLS

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HIGH PRODUCTION MACHINES

Hartness Double Spindle Flat Turret Lathe for Chucking Work

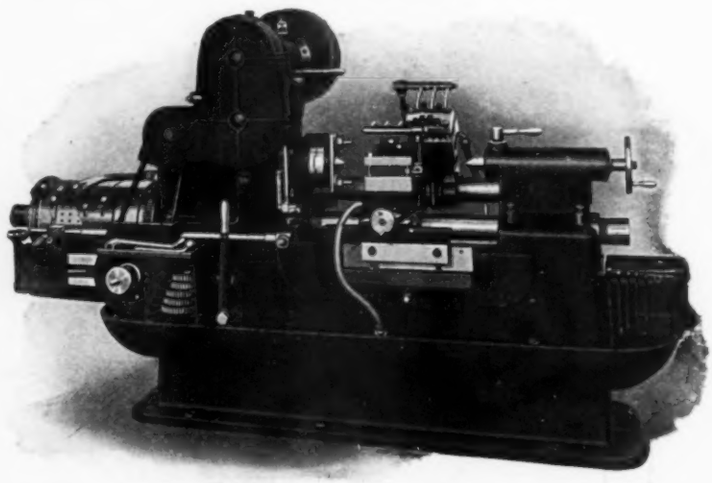
Two spindles, two sets of tools, two pieces of work. One turret, one cycle of operations, one operator. Practically double the output at about the same expense.

Introduced ten years ago, and now the leading machine in the automobile field, and in similar lines where chuck work comes in large lots.

WORKING RANGE. Swing when both spindles are used is 10 inches. Cross travel of head is 10½ inches. Hole through spindle is 3⅛ inches.

Or it may be used as a single spindle machine, with a large chuck on the rear spindle, when it swings 17 inches.

The Fay Automatic Lathe



An automatic machine for work held on centers, or carried on arbors. Particularly adapted to second operation work.

RANGE OF WORK. It swings 14 inches over the shears and 10 inches over the carriage. It will turn up to 10 inches in length, and takes 18 inches between the centers. The movements are entirely automatic, the machine stopping itself when the work is completed.

FEEDS. The movements of the various tools are controlled by adjustable cams. The cam-shaft has an adjustable quick drive for idle motions, and a slow drive through change gears for feeding.

CARRIAGE. The Carriage, attached to the central shaft, has lateral motion obtained from cams on the drum. Movement in the vertical plane is given by removable formers, mounted on former slide and operated from the drum. These two movements may be made either separately or in conjunction.

BACK TOOL ARMS. The back tool holder is adjustable on the rear shaft and has a lateral motion controlled by the cam drum. Movement in the vertical plane is obtained from a separate sliding cam. These movements may also be made separately or in conjunction.

TAPER TURNING is effected by adjustment of the straight former on the former slide operating the carriage; for steep tapers, such as the faces of bevel gears, etc., a special bevel attachment is provided, controlling the back tool arm.

FORM TURNING in wide variety is also effected by formers operating the carriage. This is especially useful in crowning cone pulleys, etc.

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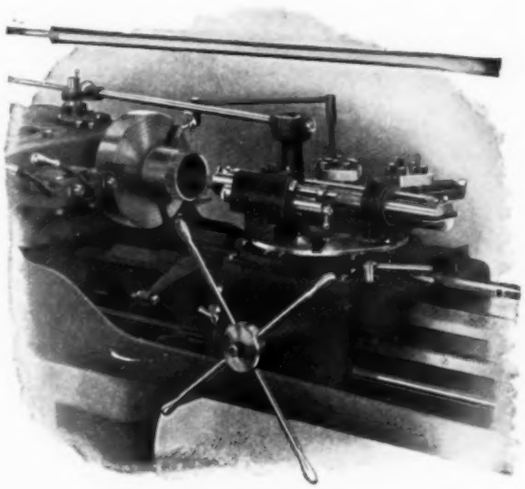
UNIQUE EQUIPMENT FOR THREADING

Automatic Chasing Attachment



The Hartness Chasing Attachment is shown applied to the Flat Turret Lathe.

This attachment is automatic. The carriage is locked to the bed and the attachment clutched with its positive drive from the work spindle. The threading tool feeds forward at cutting depth under lead screw control until the tool bar strikes a stop. The tool is then withdrawn to clear the work and returned at high speed to the starting point, where it is again fed in to cutting depth and engaged with the lead screw. The work spindle revolves continuously. The only motion required of the operator is that of adjusting the cross sliding head forward a slight amount during the return of the cutter to feed the tool in for the new cut. There is no possibility of overrunning and gouging into a shoulder, no matter how fast the machine is run.

The advantage of this attachment is that it gives engine lathe accuracy to turret lathe threading—and it gives much more than engine lathe speed.

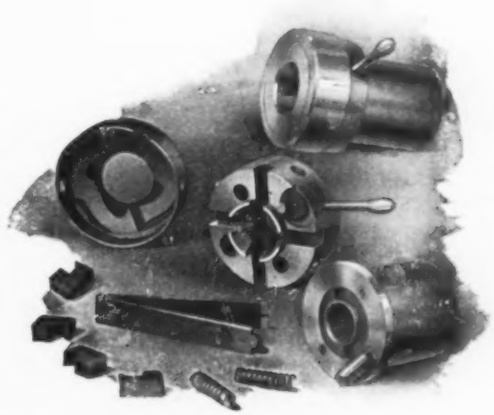
Hartness Automatic Die

Wide Range **Few Dies** **High Accuracy** **Small Expense**

The No. 1 Die threads from $\frac{3}{32}$ inch to $\frac{9}{16}$ inch diameter, all pitches. The entire range from ¼ inch to 2¾ inches for standard threads, and to 3 inches for 8 pitch or finer, is covered by three sizes of dies whose ranges overlap.

Any of these dies, even the large No. 9, will thread pitches as fine as 32 per inch on its largest diameter without danger of stripping.

The lead-controlling feature is exclusive with this die. You can cut long threads as accurate in pitch as you will get from the ordinary engine lathe.



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Power Plant Service

IT HAPPENS every day to hundreds of you engineers—you mention your problems to a Johns-Manville salesman who drops in and that's his cue to get together with you and help. The next minute finds you working together over a piping design, to kill off wet steam that's laming the pump or whatever the bother happens to be.

We are not competing with the consulting engineer. But call it service, salesmanship, or common sense—the fact remains that no Johns-Manville man is contented with mere order taking. For back of every product he sells is a Johns-Manville branch, home office, factory and technical staff, whose primary aim is to make "*Johns-Manville*" a trade name in the power field for all around service.

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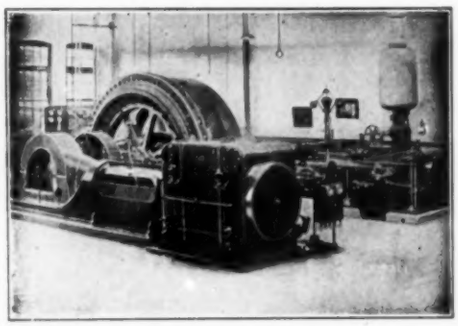
Economy—Durability—Reliability



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Standard in Steam practice everywhere.

Pickering principle of jointless construction insures closeness in regulation, continued efficiency and maximum durability.

For Steam Engines and Turbines, Gas Engines, Mechanical Control and Speed Limit.

Particularly suited to Variable Speed Engines.

We offer you our service with over fifty years successful experience.

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Rebuilding and Repairing Engines

BREAK-DOWN JOBS GIVEN SPECIAL ATTENTION

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Single and Compound, Corliss
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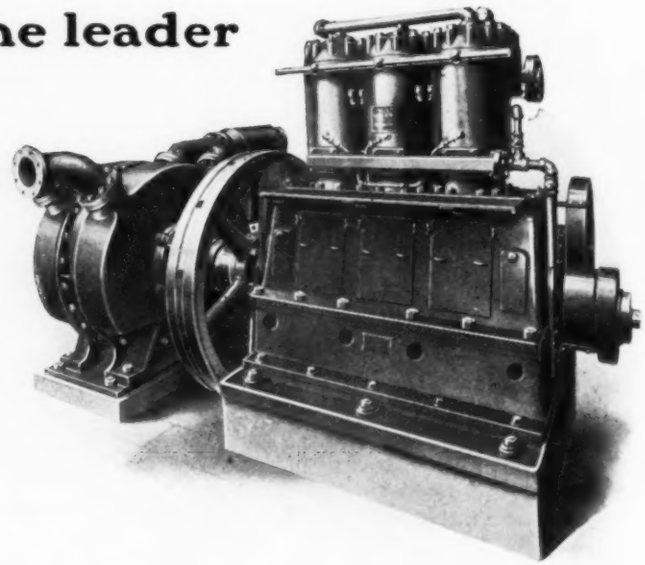
OF ALL KINDS

Shears, Punches, Saws, Coping Machines

THE NASH ENGINE

Over 30 years the leader in Vertical Gas Engine Design



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Turbine Blower for
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Pressures from 5 to
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We are in position to make early delivery on stock designs up to 50 H.P. Let us aid you in securing the engine best fitted to your needs.

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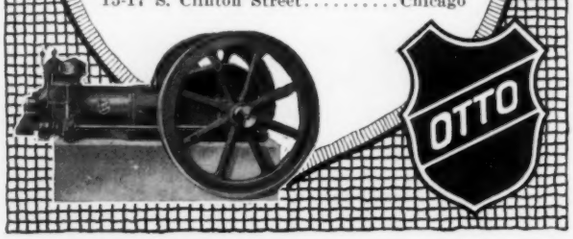

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It comprises 65,000 volumes, including many rare and valuable reference works not readily accessible elsewhere. Over 800 technical journals and magazines are regularly received, including every important engineering journal in the world in the mechanical, electrical and mining fields.

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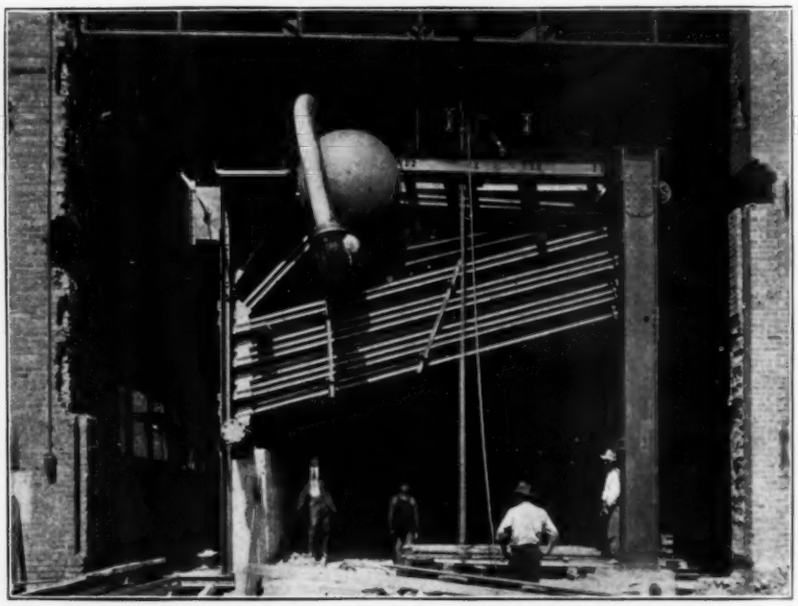
NO Staybolts—NO Braces—NO Bent Tubes
Of ALL STEEL Construction

Each section suspended independent of all other sections.

Hand holes have inside plates of drop forged steel each covering four tubes.

65% less hand holes than other horizontal W. T. boilers.

Tubes pitched 15° and large circulating area between headers and drum insures rapid steaming.



Occupy less space and require less brick than other horizontal W. T. boilers.

Having about 97% Tube heating surface—drum of large diameter and special dry pipe insures dry steam.

Baffles are indestructible and permit removal of any tube without disturbing other tubes or baffles.

Two 1000 H. P. boilers installed at the Central Illinois Light Company, Peoria, Ill.

Write for further information

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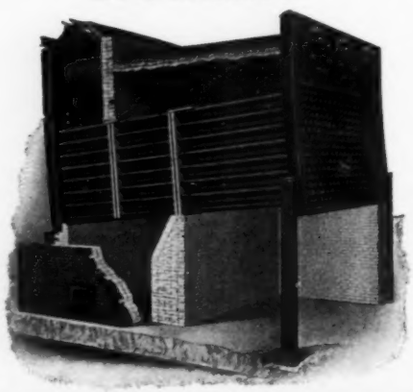
The Special Features Assuring
Economy, Efficiency and Durability
are to be found in



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These cannot be explained in the limited space of an advertisement. Those interested in steam boilers and in tests of unusual performances should send for our illustrated bulletins. The details of design and construction which assure a minimum of heat losses, low fuel cost, and general all round reliability and satisfactory service are fully given. The Edge Moor boilers

Meet the Exacting Conditions of Modern Power Plants and are Especially Suitable for those of Large Size

Our Literature Will Show Why; Send for It

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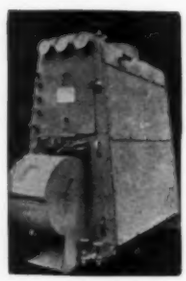
TALBOT

Oil Burning



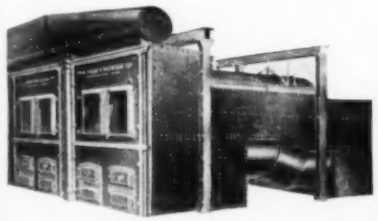
Forced Circulation

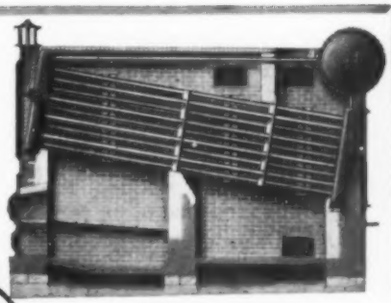
BOILERS

NON-EXPLOSIVE, — NON-SCALING, — HIGH PRESSURE, — SUPERHEATED STEAM, — COMPACT, — NO REPAIR OR DELAY COST,—CHEAP AND QUICK TO INSTALL. 89% THERMAL EFFICIENCY. WHAT EFFICIENCY AND UP-KEEP COST HAVE YOU? LET US SHOW WHAT WE CAN SAVE IN YOUR PLANT.

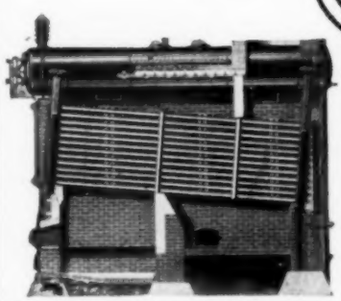
Our Booklet Describes Them Well.

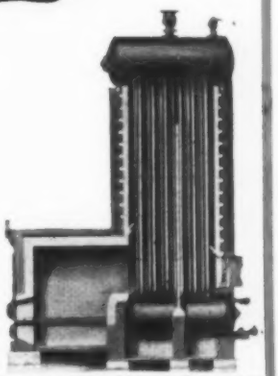
TALBOT BOILER & ENG. CORP.
120 Liberty Street, New York





A S M E CODE BOILERS





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The Casey-Hedges Co.
Chattanooga, Tenn.
CHICAGO NEW YORK HABANA

THE BABCOCK & WILCOX COMPANY

85 LIBERTY STREET, NEW YORK

WATER TUBE STEAM BOILERS

STEAM SUPERHEATERS MECHANICAL STOKERS

Works: BARBERTON, OHIO BAYONNE, N. J.

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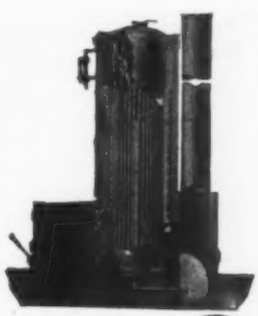
Wickes Vertical Water Tube Boiler

Ask us why engines are never wrecked and steam turbines never have erroded and clogged blades and nozzles when using this boiler?

Ask us for full data—sent free

THE WICKES BOILER CO.

SAGINAW MICHIGAN, U. S. A.



SALES OFFICES:

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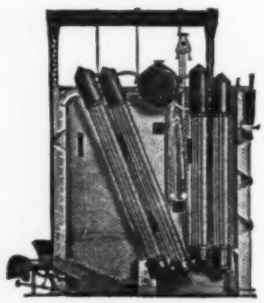
The Bigelow-Hornsby Water Tube Boiler

Features of the Bigelow-Hornsby Boiler that meet the requirements of Modern Power House Practice:

1. Unlimited size of units.
2. Small ground space occupied.
3. Coldest water meets the coldest gases.
4. Direct heating surface about four times as great as the average water tube boiler.
5. All parts, both external and internal, readily accessible.
6. All boiler tubes perfectly straight.
7. Circulation of water and liberation of steam unrestricted.
8. Very dry steam, also ample room for superheaters where required.
9. High continuous economy due to extreme cleanliness of the most efficient heating surface.



Cross Sectional View Through the Brickwork

10. Arrangement of baffling is unique, causing the gases to pass over the heating surface in thin streams and uniformly at every point.
11. Furnace arrangement is ideal for securing perfect combustion, as furnace is correctly shaped and of ample size.
12. Greatest flexibility, both as to construction and in steaming qualities.
13. No cast iron used in any portion of the boiler proper.
14. Constructed both as to workmanship and material in accordance with the most advanced boiler practice.

THE BIGELOW COMPANY

New York Office
85 Liberty St.

Works and Main Office
76 River St., NEW HAVEN, CONN.

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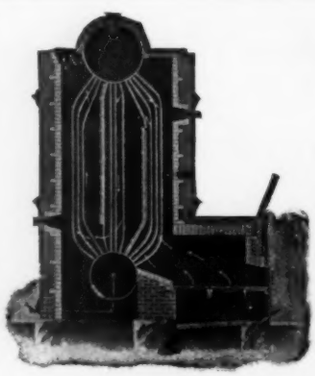
141 Milk St.

Also Manufacturers of the Bigelow-Manning and Horizontal Return Tubular Boilers, Digesters, Crystallizers, Vulcanizers and Heavy Plate Steel Work

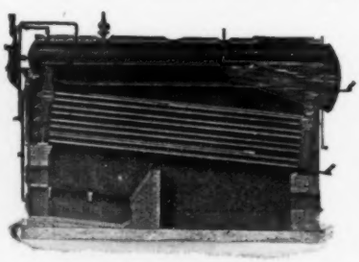
SAFER BOILERS



Erie City Vertical Water Tube Boiler

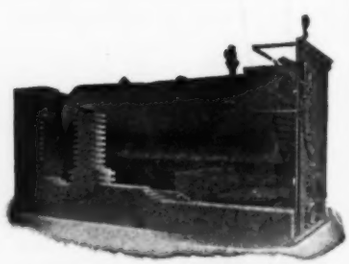
A signal event for the boiler industry was the completion of the A. S. M. E. Boiler Code. This report, containing standard specifications for the construction, equipment and use of steam boilers, embodies the collective knowledge of the world's best experts. Its adoption by the Society marks a new era in the manufacture of steam boilers, and will prove the inauguration of a great movement for the protection of human life and property.

Erie City "Economic" Boiler



Erie City Horizontal Water Tube Boiler

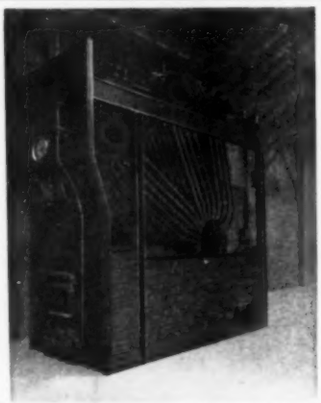
We are now building all types of boilers to meet the specifications of the A. S. M. E. Boiler Code.



Erie City Return Tubular Boiler

ERIE CITY IRON WORKS, Erie, Pa.

Manufacturers of Steam Engines and Boilers and Feed Water Heaters; Horizontal and Vertical Water Tube Boilers; Lentz Engines



Connelly Water Tube Boilers

are built in units from 100 hp. to 4,000 hp. and for pressures up to 300 lb. They have 100% tube area in the path of the circulation, deliver steam superheated from 5 to 15 deg. at any rating, and can be operated at 200 to 300% of rating. The boiler has no flat surfaces, no staybolts, braces or crown bars. Open four manholes and boiler is ready for inspection and internal cleaning.

Boiler here shown is carrying 300-lb. steam, has a superheater, giving a final steam temperature of 875 deg.

Send for bulletin "A"

The D. Connelly Boiler Co., Cleveland, Ohio

Founded in 1875 by Daniel Connelly

We have the most modern boiler manufacturing plant in America

SUPERHEATERS

For All Types and Makes of Boilers
Any Range of Superheat

All Steel—Indestructible; Get Catalogue

SUPERNO COMPANY, Inc.
52 Broadway, New York

Heine Boilers

ENGINEERS:
Send for a copy of the book
"BOILER LOGIC"
It discusses the Design of Heine Boilers and Their Operation. Also ask for pamphlet "Superheater Logic"
HEINE SAFETY BOILER CO.,
5320 Marcus Ave., St. Louis, Mo.

Green Radial Flow Fans

mean

Hi-Speed Hi-Efficiency

For forced and induced draft service

THE GREEN FUEL ECONOMIZER CO.

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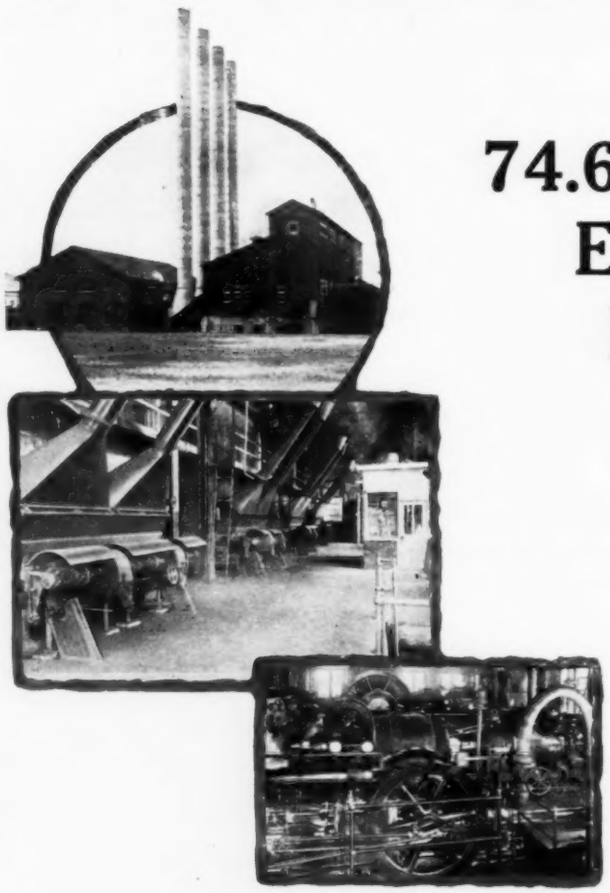
90 West St., N. Y. City **Works: Beacon, N. Y.**

Offices in all principal cities of U. S. and Canada.

The Taylor Stoker



74.69% Average Efficiency on Illinois Slack (9800 B.T.U. as Fired)!

And here's another plant where the TAYLOR Stoker is getting not only *big capacity,* but *high efficiency,* out of low grade coal—at the Walworth Mfg. Co., Kewanee Works, Kewanee, Ill.

The coal burned—Illinois Slack—runs 11,250 B. t. u. (dry coal); moisture about 14%; ash, 18% to 20%. It will be seen from these figures that this coal, as fired, yields only about 9,800 B. t. u.

And yet, notwithstanding this low grade fuel, average boiler and stoker performance at this plant over the entire past *year* shows 74.69% efficiency!

This, too, despite the fact that operating conditions necessitate banking one boiler each evening and putting it in service again the next morning.

American Engineering Company, Philadelphia

Green Chain Grate Stokers

GREEN ENGINEERING CO.
EAST CHICAGO, IND.

Bulletins on Request

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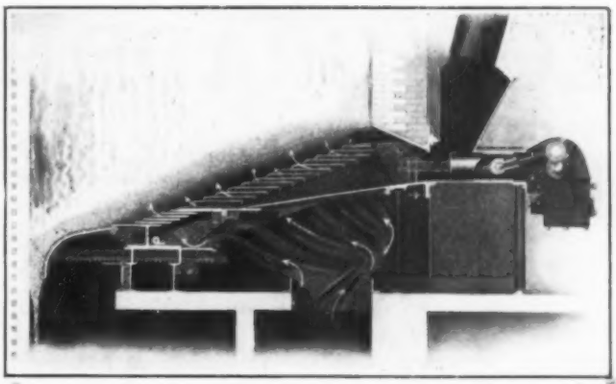
Geco Steam Jet Ash Conveyors



Sectional view of Riley Underfeed Stoker showing operation.

RILEY UNDERFEED STOKERS

Automatically clean and continuously discharge the ash and do not allow the refuse to encroach on the fuel burning capacity of the stoker. That's why RILEY STOKERS burn more fuel per square foot of grate area, and burn it more efficiently than any other device.

Every feature that tends to promote economy of operation is incorporated in RILEY STOKER design. Our descriptive catalog A-2 will interest you. Send for it.

Sanford Riley Stoker Co., Ltd., Worcester, Mass.

Sales inquiries direct to home office, Worcester, or branch offices of B. F. Sturtevant Company, Sales Agents. British Licensees: Erith's Engineering Co., Ltd., London. French Licensees: Erith, Leroy & Cie., Paris, France.

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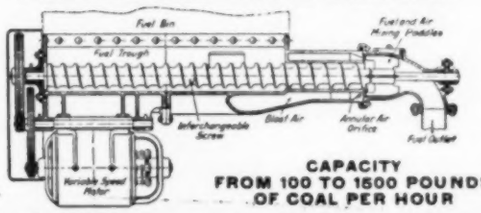
PULVERIZED FUEL FEEDER



CAPACITY
FROM 100 TO 1500 POUNDS
OF COAL PER HOUR

Is adapted for any existing installation, comparative operating advantages being thorough commingling of fuel and air, uniform feed, and low delivery pressure.

Consult us about your steam or metallurgical fuel problems.

Locomotive Pulverized Fuel Company
30 CHURCH STREET NEW YORK CITY

If you are Going to Buy a MURPHY STOKER Buy it NOW!

Today your Murphy Stoker is a better investment than ever before. Don't hesitate putting in the stoker equipment you need because you think prices and deliveries are prohibitive.

As the largest individual manufacturers of stokers in the world, we can make relatively prompt shipment on all orders placed at once—and compared to the increased cost of raw materials, the advance in the price of Murphy Stokers has been surprisingly slight.

The extent of activity of many a plant for months to come is going to depend on its ability to get coal its stokers will burn—and with Murphy Stokers installed under your boilers, you are prepared to **burn efficiently the coal you can get.**

Be independent of the coal market—find out how you can master the situation permanently with Murphy Stokers. Write us brief particulars of the conditions with which you are contending—and our engineers will suggest a solution to you at once. Ask for catalog "B."

MURPHY IRON WORKS, - - Detroit, Michigan, U. S. A.

LOW GRADE HIGH ASH COAL

BURNED EFFICIENTLY

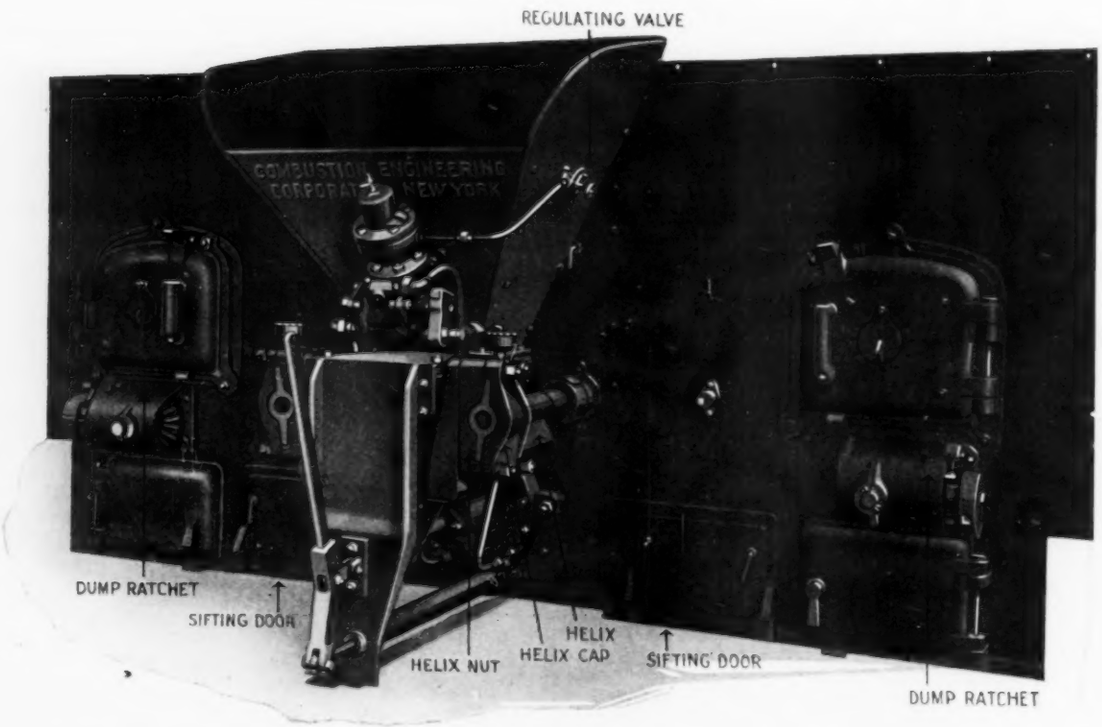
BY

TYPE E STOKERS

Mechanical Cleaning Automatic Control

GET IN TOUCH WITH US

TO SOLVE THE FUEL AND LABOR
SHORTAGE IN YOUR PLANT



COMBUSTION ENGINEERING CORPORATION NEW YORK

Combustion Engineering Corporation

11 BROADWAY, NEW YORK CITY

Owners and Manufacturers of

Type "E" Stoker—For Bituminous Coal
The Grieve Grate—For All Hand-Fired Fuels.

Sole Representatives

Coxe Traveling Grate Co.—The Automatic Anthracite Stoker.

NEW YORK CITY PHILADELPHIA, PA. PITTSBURGH, PA. CHICAGO, ILL. SALT LAKE CITY, UTAH
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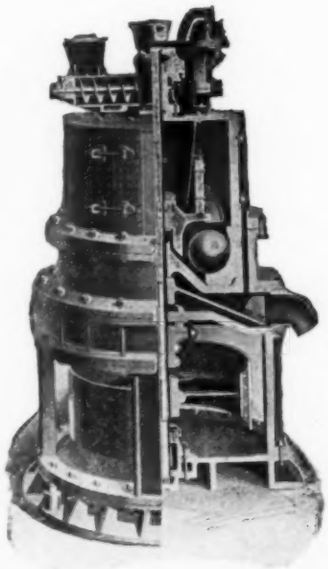
Pulverized Coal Equipment

The types of furnaces heated with Pulverized Coal are widely diversified and include



Annealing Furnaces
Bar Heating Furnaces
Billet Heating Furnaces
Calcining Furnaces
Drying Furnaces
Forge Furnaces
Nodulizing Furnaces
Open Hearth Furnaces
Ore Roasting Furnaces
Piled Scrap Heating Furnaces
Puddling Furnaces
Rotary Cement Kilns
Rotary Lime Kilns
Steam Boiler Furnaces

The satisfactory performance of our Pulverized Coal Equipment warrants your investigation. We manufacture Coal Crushers, Dryers, Fuller-Lehigh Pulverizer Mills, and Pulverized Coal Feeders. All this equipment is described in our Catalogue No. 71 which we will be pleased to send you.

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Scientific Water Purification
for ALL PURPOSES
Softening and Filtering Systems
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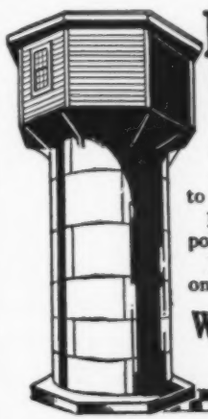

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Automatically removes scale forming and corrosive matter from water at an average cost of from 1c to 2c per 1000 gallons.

Results guaranteed from every standpoint.

Detailed information gladly furnished on request.

Wm. Graver Tank Works
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One of the largest collections of engineering literature in the world is the Engineering Library in the Engineering Societies Building, 29 West 39th Street, New York.

It comprises 65,000 volumes, including many rare and valuable reference works not readily accessible elsewhere. Over 800 technical journals and magazines are regularly received, including every important engineering journal in the world in the mechanical, electrical and mining fields.

The library is open from 9 a.m. to 10 p.m, with trained librarians in constant attendance. Its resources are at the service of the engineering and scientific public.

DIAMOND SOOT BLOWERS

Are doing their Bit-

Chosen for the First American Cantonment in France.

"Cost more and worth more"

Save 4% to 8% of Fuel

With Our Expeditionary Forces

THE first cantonment erected by Uncle Sam on French soil contains a number of boilers for heating and refrigerating purposes, and these boilers are each equipped with Diamond Soot Blowers!

In all the tremendous rush to complete the plans and purchase the material the Government did not forget Diamond Soot Blowers, but specified them and demanded immediate shipment by express.

Now, why?

We are safe in saying that no product not absolutely basic would have stood the Government's cold, scientific scrutiny. It's action was determined by experts, who took into account every factor surrounding the operation of the boilers. Military necessity alone governed the decision to give valuable departmental time, valuable cargo space, valuable railroad transportation in France and valuable Army Engineers' time in erection, to Diamond Soot Blowers.

Coal and labor are at a premium in France today, and the Government is conserving them by the most effective means known—Diamonds.

In taking this action the Government has confirmed not only its judgment regarding its own former satisfactory experience with Diamond Soot Blowers, but the experience of such important users as:

Ford Motor Company
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And hundreds of others of our biggest power users, all of whom have purchased Diamonds.

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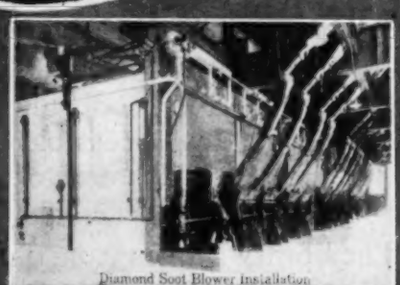
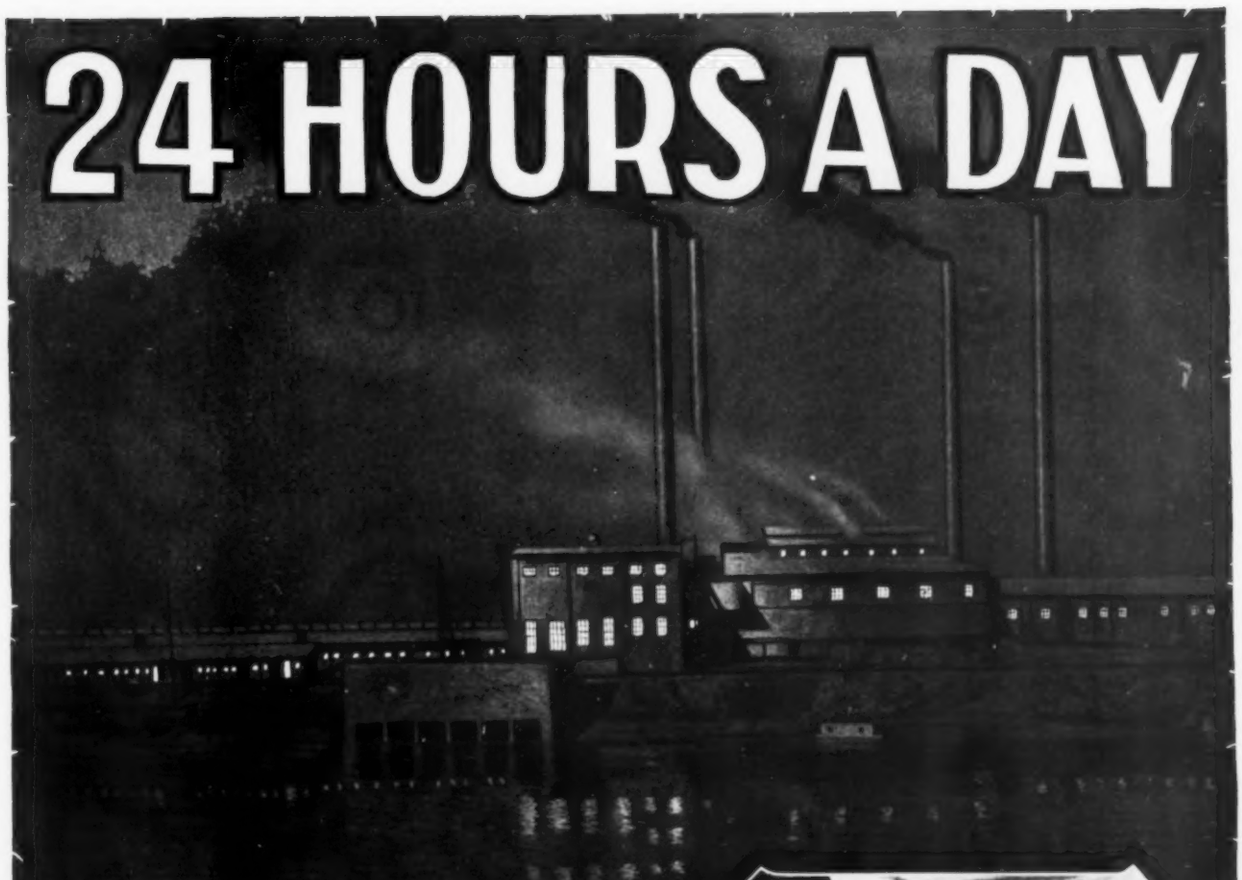
Sales and Service Branches in all large cities of the United States, Canada, Cuba and Hawaii

An Interesting Bit of America in France

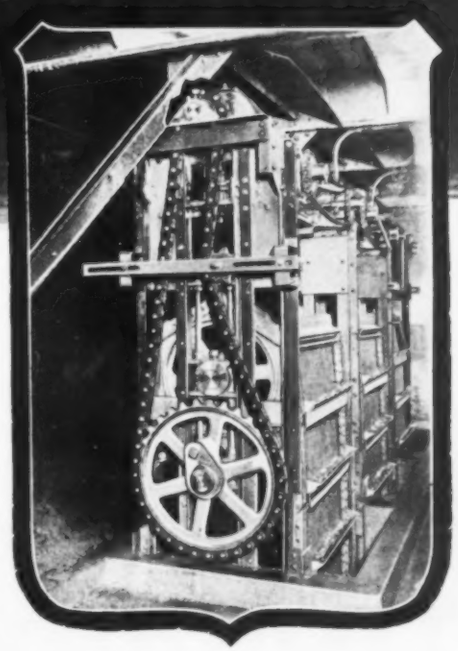


Diamond Soot Blower Installation

24 HOURS A DAY



That's the service you must have.



REX Traveling Water Screens
will keep your intake water clean twenty-four hours a day and three hundred and sixty-five days a year.

They will:—

Conserve your coal
Conserve your man power
Increase your operating efficiency
Reduce your boiler and condenser maintenance
Eliminate your old fashioned stationary screens

What **Rex Traveling Water Screens** have done for others they can do for you.

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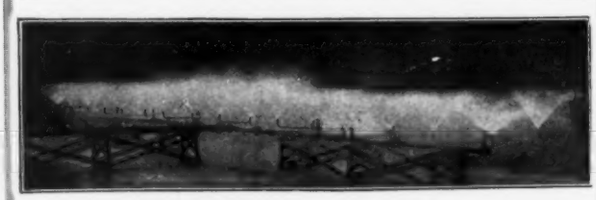
CHAIN BELT COMPANY

710 Park Street **REX PRODUCTS** **Milwaukee, Wisconsin**

A.S.M.E.



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For Cooling Condensing Water

Spray Cooling Ponds equipped with our special "Spraco" Cooling equipment, require only from five to seven pounds pressure per square inch at the nozzle. With this pressure, the water is thrown to a height of from five to seven feet above the tip of the nozzle in a uniform, dense, conical spray.

We find from our experience in designing over four hundred ponds, now in successful operation in the United States and other countries, that it is impossible to lay down exact rules for the design of these ponds, as local conditions make each case a special problem. Hence, if the amount of water to be cooled, the amount of steam condensed in heating this water, the cooling or vacuum desired, as well as the dimensions of the space available for the installation and whether on ground or roof are given us we will be pleased to send complete specifications and sketch of arrangement, best suited to conditions given.

SPRAY ENGINEERING CO.

93 FEDERAL STREET

BOSTON, MASS.

Engineers

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SPRACO PRODUCTS

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2

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—for—

High vacua on turbines up to 5000 K. W.

WRITE FOR CATALOG 5-AB

SCHUTTE & KOERTING CO.

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Morehead Back to Boiler SYSTEM

For Feeding Boilers Returns the condensation with its *full* heat content direct to boilers—*and without pumps*. Every steam user needs the *Morehead System*. Can be used with any kind of service.

Get complete information from our Engineers. Write today.

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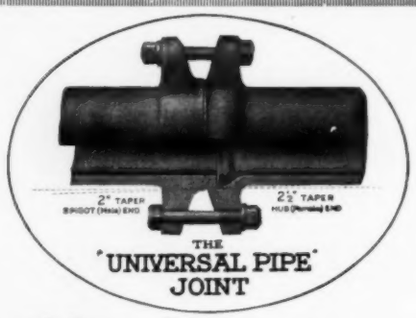

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No labor problem here—

Any shop hand with enough intelligence to use a ratchet wrench can install Universal Pipe.

A few easy turns of the wrench and the machined hub and spigot ends of the pipe are made into ***durable, flexible*** and ***tight*** joints—joints that **stay** tight despite constant and heavy vibration.

Tested and Approved by the Fire Underwriters.

Handy pocket Catalogue upon request. or see your A. S. M. E.—or Sweet's Engineering Catalogues.

FOR WATER AND GAS AND ALL GENERAL PURPOSES— UNDER THE GROUND, IN THE BUILDING.

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Sales Offices—New York, Chicago, Atlanta, Dallas, San Francisco

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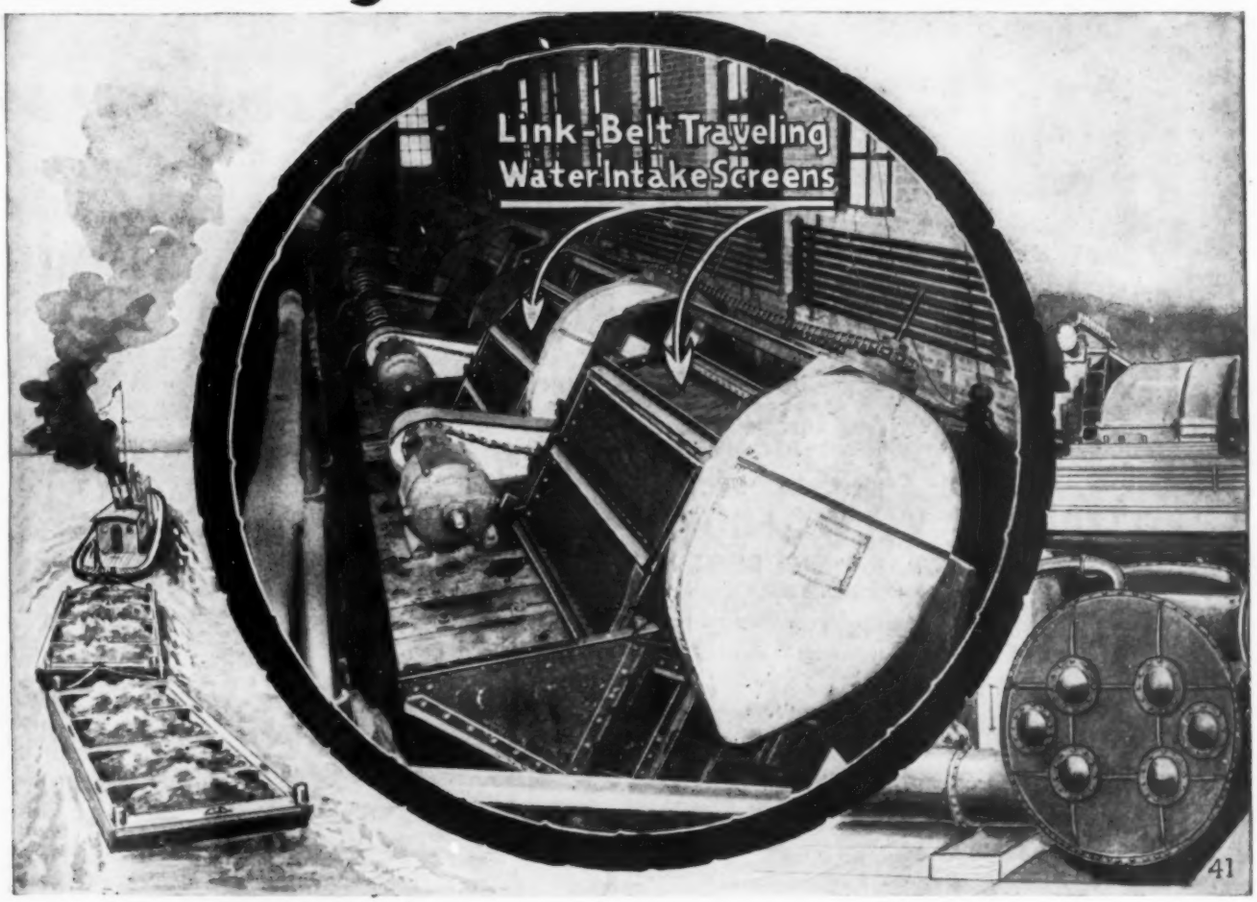
LINK-BELT

Traveling Water Intake Screens



Operate Between the Water Supply and the Condensers

ALL TRASH is automatically removed from the condenser water by the Link-Belt Traveling Water Intake Screens. Uninterrupted operation is assured at all times regardless of the condition of the water supply.

Link-Belt Traveling Water Intake Screens are a necessity in the modern power plant. Stationary screens have proved inadequate. Link-Belt Traveling Water Intake Screens are dependable at all times, and under all conditions.

If you want the BEST Traveling Water Screen, go to the ORIGINAL and Oldest Manufacturers of this useful device.

LINK-BELT COMPANY

PHILADELPHIA

New York.....299 Broadway
Boston.....49 Federal St.
Pittsburgh.....1501 Park Bldg.
St. Louis.....Central National Bank Bldg.
Buffalo.....698 Ellicott Square
Wilkes-Barre..Second National Bank Bldg.
Cleveland.....429 Rockefeller Bldg

CHICAGO

Detroit.....732 Dime Bank Bldg.
Minneapolis.....418 S. Third St.
Kansas City, Mo.....407 Finance Bldg.
Seattle.....576 First Ave., S.
Portland, Ore.....1st and Stork Sts.
San Francisco.....461 Market St.
Los Angeles.....161 N. Los Angeles St.

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Denver.....Lindrooth, Shubert & Co.
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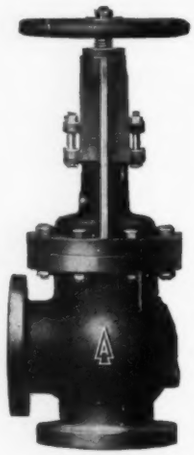
Knoxville, Tenn.D. T. Blakey, Empire Bldg.
Birmingham.....
.....McCrossin & Darrah, Am. Tr. Bldg.
New Orleans.....
.....C. O. Hinz, Hibernia Bank Bldg.

NON-RETURN VALVES

ANGLE VERTICAL or STRAIGHTWAY



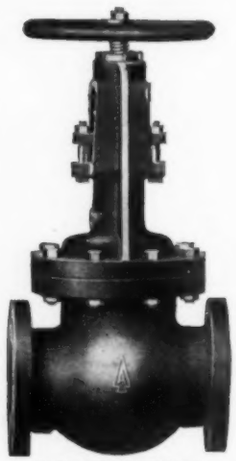
ANGLE

FOR

SUPERHEATED STEAM
CAST STEEL
MONEL MOUNTED

VERTICAL

SATURATED STEAM
SEMI STEEL
BRONZE MOUNTED



STRAIGHTWAY

SPECIAL FEATURES:—

UNDER SIDE OF DASHPOT OPEN TO PREVENT COLLECTING OF SEDIMENT.
EASY FLOW TO REDUCE BACK PRESSURE TO A MINIMUM.
ACCURATE AND POSITIVE ALIGNMENT OF DISC.
BALANCED DISC TO PREVENT HAMMERING.

Complete Piping Systems Furnished and Installed

PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION CO.

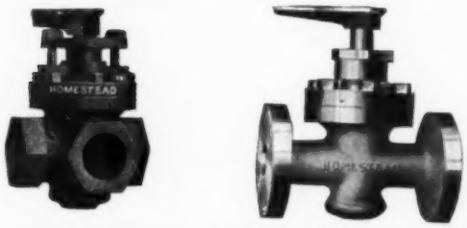
PITTSBURGH, PA.

1 ENGINEERS FOUNDERS PIPE-FITTERS MACHINISTS

SEE OUR DATA IN 1907 A.S.M.E. CONDENSED CATALOGUES OF MECHANICAL EQUIPMENT

SAFE *and* ECONOMICAL Plant Operation

Depends in a great measure upon the selection of Tight, Dependable and Efficient Valves



HOMESTEAD QUARTER TURN VALVES

are a by-word for efficient and dependable service on the most troublesome lines in the largest industrial plants where they are doing their share to make the plant "safe for efficient operation."

Why not profit from experience and order a HOMESTEAD today?

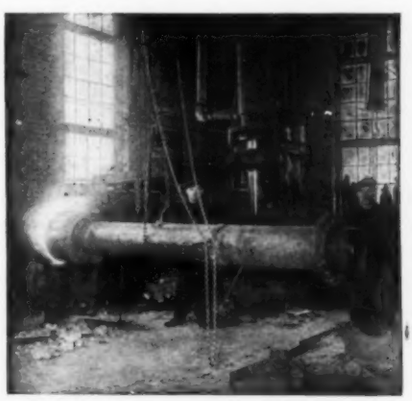
Write—

Homestead Valve Mfg. Co.

Homestead, Pa.

SEE OUR DATA IN 1917 A.S.M.E. CONDENSED CATALOGUES OF MECHANICAL EQUIPMENT

Steel Valves, Steel Fittings
Pipe Bend, Walmanco Flanges,
Everything for Power Piping



We make a full line of such material of Walworth quality

Walworth Mfg. Co.

New York Boston Chicago

It will save money for you, too—

JUST as it has done for the Bethlehem Steel Co., National Cash Register Co., Remington Typewriter Co. and other concerns of like calibre. Each of these big corporations — widely known for the efficiency of their equipment—have been for several years users of

Simplex "Seatless" Blow-off Valves

But money saving is, perhaps, not the point that stands out strongest in the minds of its most satisfied users. It is the dependable, uniform service that the Simplex gives. For instance—

A manufacturer informs us that on one of his boilers there is a Simplex "Seatless" Blow-Off Valve that has been operated twice daily for nine years, and did not require repacking for three years.

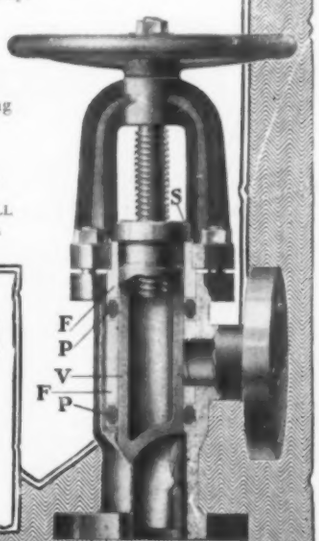
We have scores of records showing the remarkable service qualities of this Seatless Valve.

You can easily learn the good points of the Simplex, for we will send you one for 60 days' trial. Write stating size of line, whether flanged or screwed, angle or straightway.

Yarnall-Waring Company

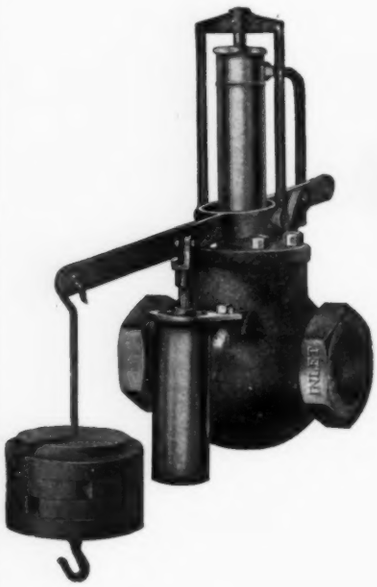
7612-20 Queen Street

CHESTNUT HILL PHILADELPHIA



DESCRIPTION:—

In closing valve, shoulder S on Plunger V engages the loose follower gland F, compressing packing P above and below the port making an absolutely tight valve.



DAVIS
PRESSURE REGULATOR

The first and original pressure regulator of America—42 years old and the leader today.

Piston type with counterweighted lever control. Visible operation—ready means for testing. No springs or toggles—no small ports—no diaphragm—no packing.

This valve is your solution for pressure control of steam, water, air or oil, whether the pressure be as high as 200 lb. or whether it's as low as 1 lb.

Catalogue on request

Visible Operation

G. M. Davis Regulator Company
439 Milwaukee Avenue, Chicago

New York, 123 Liberty—Boston, 70 High—Philadelphia, 222 N. 22nd St.—The Renshaw Bldg., in Pittsburgh—Calvert in Baltimore and Rialto in San Francisco.

Valve Specialty Manufacturers Since 1875

Nearly everything made for the

HEALTH—COMFORT—SAFETY

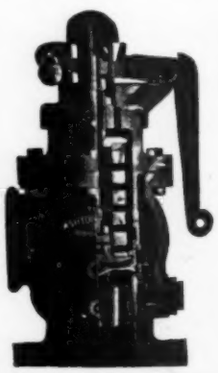
of mankind depends upon power at its source.

CRANE CO.

makes more than 17,000 articles for handling steam, water, gas, air, oil, etc.

CHICAGO **CRANE CO.** BRIDGEPORT

Branches in 53 leading cities



Ashton Pop Safety and Relief Valves
Pressure and Vacuum Registering and Recording
GAGES

Dependable in Quality and Service with an enviable record of over 40 years.

The Ashton Valve Co.
Boston New York Chicago

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THE LUDLOW VALVE MFG. CO.
TROY, N. Y.

GATE VALVES FOR
HIGH PRESSURE STEAM
Also Water, Oil, Natural Gas, Ammonia
FIRE HYDRANTS, SLUICE GATES

BRANCH OFFICES
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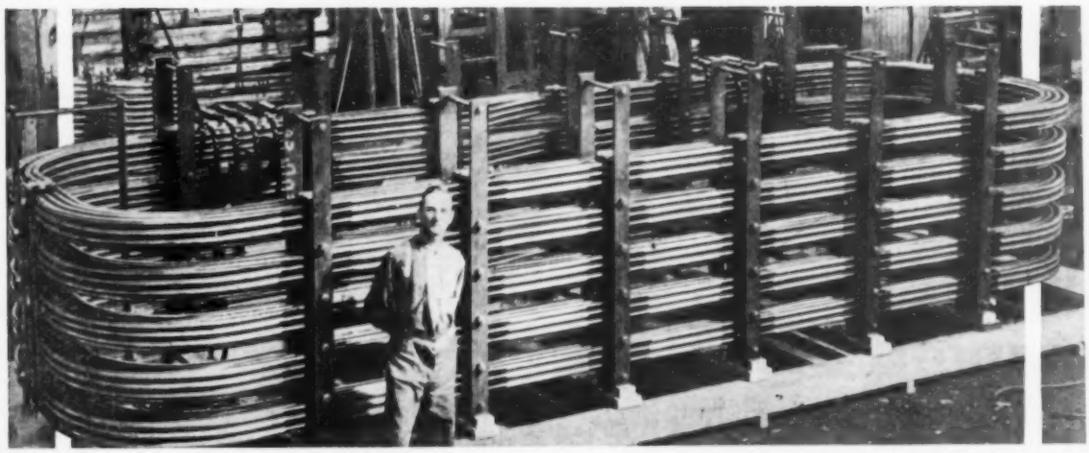


Experience—Equipment—Responsibility in making Pipe Coils

When you are to install a pipe coil, whether for cooling or heating, whether for kettles, for refrigeration, for refining gasoline, or other service, you don't try to make it yourself—you may not have the necessary experience and equipment, and you don't want the responsibility for spoiled material. You naturally turn to

The National Pipe Bending Company

Experience in making pipe coils is absolutely necessary, especially for important or difficult work, and where failure to render the guaranteed service will cause trouble.

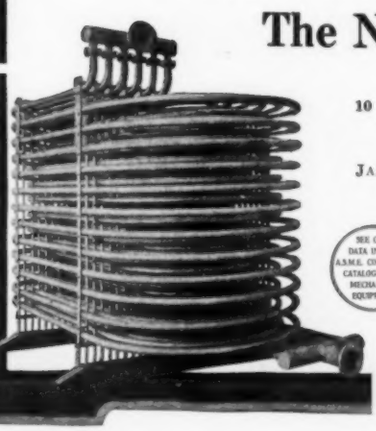
Equipment is no less important, for it takes the best welding, brazing, and bending machines to turn out dependable coils.

Responsibility for quality cannot be overlooked. If you try to make an occasional coil, you must take the responsibility for spoiled material, and defects in welding and bending.

You put the responsibility up to the company who has been making pipe coils—difficult ones—large ones—for more than thirty years, for these years have accumulated the necessary experience and equipment and know-how that enables this company to assume the responsibility for quality and delivery.

The National Pipe Bending Co.

New Haven, Conn.



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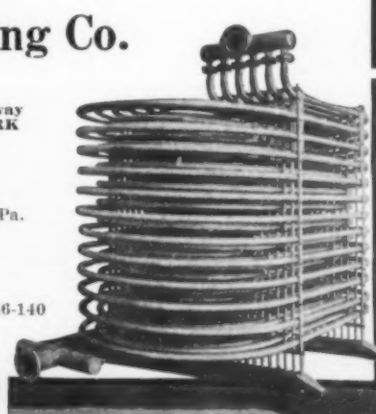
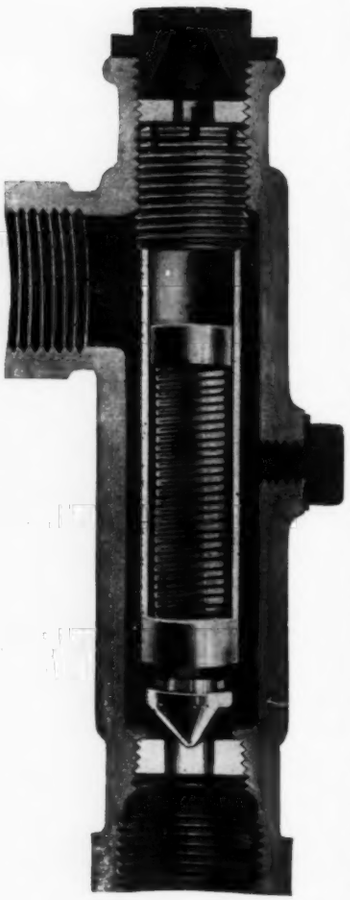
46-140



The Steam Trap with but One Moving Part



That's the SARCO

YOU can replace bucket or float non-return traps with the Sarco. When you do, you throw out of service trouble makers with joints, floats, levers, toggles, etc., etc., and replace them with a Steam Trap with but one moving part operated hydraulically and absolutely reliable. You save in first cost, save in repair cost and save in worry cost.

Send for printed data

SARCO COMPANY, Inc.
Woolworth Building New York City

Ellicott Square, Buffalo — New Telegraph Bldg., Detroit
Drexel Bldg., Philadelphia — Monadnock Block, Chicago
and representatives in all principal cities
Canada, Peacock Brothers, Montreal

Bailey Meters

are used for

STEAM FLOW, either superheated, high pressure, low pressure or exhaust, with or without pressure and temperature recorders.

BOILER OPERATION, to secure maximum efficiency and capacity.

FEED WATER, when metered between pump and boilers, or if metered on suction side of pump in combination with V-Notch weir meter.

METER CALIBRATION—Steam or water meters accurately calibrated in place.

BOILER BLOW OFF, leakage as well as total.

DRAFT, or any air gas pressure between 6" suction or 6" pressure.

COMPRESSED AIR, from compressors, distribution lines, etc.

NATURAL GAS, or other Gases at reasonably high velocities and at any pressure.

Write for Bulletins

Bailey Meter Co.
141 Milk Street, Boston, Mass.

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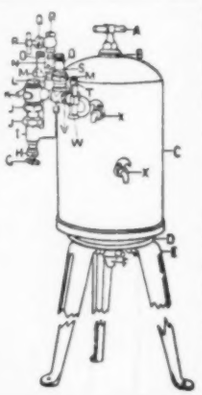
"Lackawanna" Series Lubricator

Designed to furnish lubricant to a series of cylinders from the one supply. Its special circulating pipe keeps a constant flow of fresh water through the sight glass, and the heating attachment keeps the oil at a uniform temperature. We have hundreds of endorsements.



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CRESCENT MFG. CO.
SCOTTDALE, PA.

ROCHESTER
Automatic Lubricators

For use on all types of steam engines and pumps and air and ammonia compressors.

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SOLE MANUFACTURERS

GREENE, TWEED & CO.
109 DUANE STREET, NEW YORK

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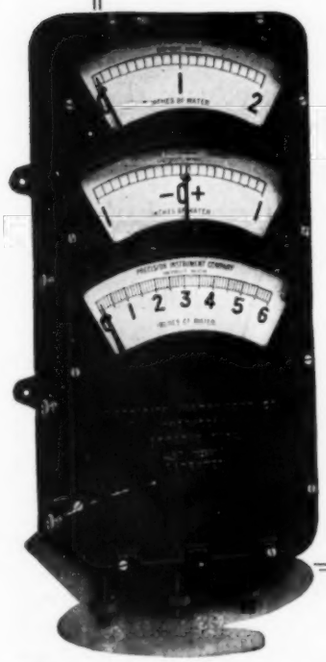
Efficient Fuel Burning Demands Intelligent Draft Control



No matter how experienced your men are in managing furnace draft their judgment will err one way or other. And even though you have *mechanical* draft control it won't do to blindly trust to a *machine*. It takes *intelligence* to really regulate draft properly, intelligence guided by a continuous *knowledge* of actual draft conditions. That's why you need the

PRECISION "3 in 1" Air Gauge

A gauge that *tells at a glance* the draft pressure at *three* important points, i.e., the Damper, the Combustion Chamber and the Ash Pit. Once installed in your plant and your engineer will wonder how he ever got on without it—and *you* will wonder *why* you ever got on without it. Proof? —*write*.

Precision Instrument Company

ENGINEERS

Detroit, Michigan

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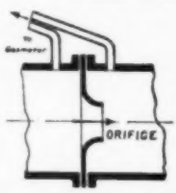
The Large Magnification of HYDRO Recording Gas Meters



Allows the Measuring of the lowest differential Pressures

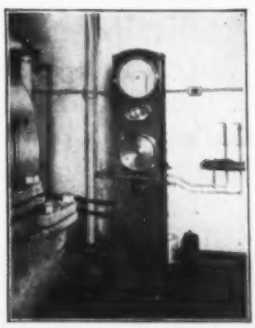
LET US ASSIST YOU IN SOLVING YOUR GAS PROBLEMS

WRITE FOR CATALOGUE "C"

BACHARACH INDUSTRIAL INSTRUMENT CO.

PITTSBURGH, PA.

AN IDEAL STEAM METER



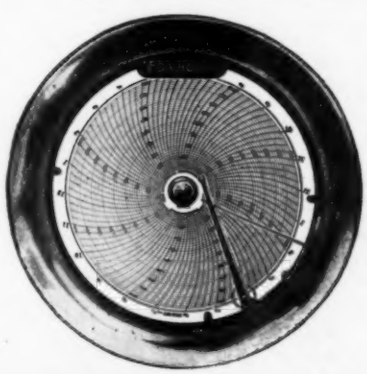
The Venturi Meter presents many signal advantages for the measurement of steam. It has a wide measuring range, registers the total flow *directly* in pounds, also indicates and records the rate of flow, and does not cause an appreciable loss in pressure.

The cut shows a Venturi Steam Meter in the power plant of the Hill Bldg., New York City, for determining the steam consumption by the engines and to aid in the regulation of valves.

Bulletin No. 79-M sent on request.

BUILDERS IRON FOUNDRY, Providence, R. I.

New York Pittsburgh Chicago San Francisco Portland



CONSERVATION OF COAL

is one big way to Render Patriotic Service to Your Country! You can save coal and money by efficient maintenance of your Power Plant.

FOXBORO TRADE MARK

RECORDING GAUGES

efficiently record the workings of your Power Plant.

Bulletin A O-96 briefly describes the FOXBORO line

THE FOXBORO CO., INC., FOXBORO, MASS., U. S. A.

New York, Chicago, Pittsburg, Philadelphia, St. Louis, Birmingham, San Francisco, Peacock Bros., Montreal, Canada.

HEADQUARTERS

ON either side, in this great conflict, the great strategists sit at Headquarters, far removed from the din and confusion of the front line, directing the action.

Numberless scouts and messengers on wheel, on wing and by wire bring them the details of every move. Headquarters has its fingers on the pulse of all action. Headquarters has a perfect and accurate picture and plan of the entire scope of combat, more perfect, more complete than that in the minds of those immediately engaged on any small sector.

It is the mass of carefully compiled information, checked by experts, that gives Headquarters the large and definite view of all things.

And so it is at our Headquarters in our fight on Friction and Power Loss.

Our scouts are our technically trained Salesman and our Lubrication Engineers scattered over the face of the land, watching, checking and noting results in plants of all kinds, on units of all descriptions.

They send in daily reports. These are checked, tabulated and classified. They continually add to the sum total of the experience in matter pertaining to lubrication, available at Headquarters. Thus, if you have such and such a machine and the difficulty is thus and so,—tell Headquarters.

Without guess work, without doubt, we will solve your problem. We have met and overcome your condition before and in the next mail we can tell you how to remove the cause. We recognize the cause and give the remedy in the shape of the right Texaco Lubricant for the purpose.

For there is a right Texaco Lubricant for every purpose.

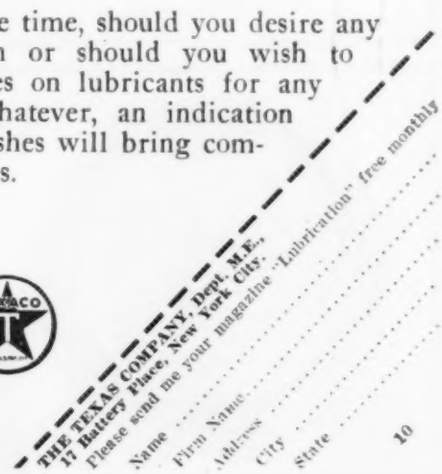
It may be for engine, turbine, dynamo, motor, or machine of any kind. There is a carefully prepared Texaco Lubricant made to meet the individual requirements of speed, pressure, heat or surrounding conditions.

And we shall be glad to tell you which Texaco Lubricant to use and why.

The thousands of plants who are using Texaco Lubricants and who have achieved a high degree of efficiency, are at once a recommendation of our careful analysis and a reason why you should consult TEXACO Lubricating Headquarters when you have any difficulty of any kind.

To keep in touch with our friends, and those who will sooner or later become our friends, we publish a monthly magazine called "Lubrication." It contains interesting items on lubricating problems in general and specific mention of successes obtained by the use of Texaco Lubricants. You can have your name put on the mailing list to receive this, without obligating yourself in any way, by filling in the attached coupon.

At the same time, should you desire any information or should you wish to know prices on lubricants for any purpose whatever, an indication of your wishes will bring complete results.



THE TEXAS COMPANY

Dept. M. E., 17 Battery Place, New York City

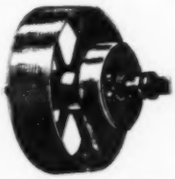
Houston Chicago New York

Offices in Principal Cities

There is a Texaco Lubricant for Every Purpose.
Texaco Lubricating Service Goes Into Every Branch of Mechanical Activity.

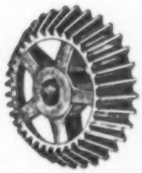
THE A. & F. BROWN CO.

ENGINEERS, FOUNDERS, MACHINISTS AND MILLWRIGHTS



Friction Clutch Pulleys and Couplings

POWER TRANSMISSION MACHINERY
DESIGNED, FURNISHED AND ERECTED



Gears of all kinds and sizes

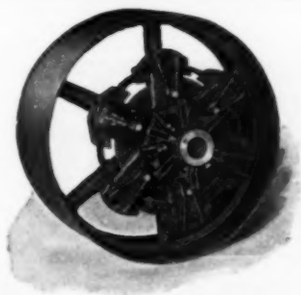
SPECIAL MACHINERY

IRON CASTINGS

WORKS: ELIZABETHPORT
NEW JERSEY

SALES ROOM: 79 BARCLAY ST.
NEW YORK CITY

Only Makers of "CUMBERLAND GROUND" Shafting
Large Stocks Quick Shipments



6-Arm Friction Clutch Pulley

Power Transmission Appliances

FOR

BELT AND ROPE DISTRIBUTION

Mechanical, Economical, Efficient

Friction Clutch Pulleys
Friction Clutch Couplings
Friction Clutch Operators
Head Shaft Hangers
Sheaves
Hangers and Pillow Blocks
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Forged and Turned Shafts, etc., etc.

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Modern and Approved Appliances for the Transmission of Power

SHAFTING
COUPLINGS
COLLARS
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PULLEYS
BELT TIGHTENERS
FRICTION CLUTCHES
ROPE DRIVE EQUIPMENTS

T. B. WOOD'S SONS CO.
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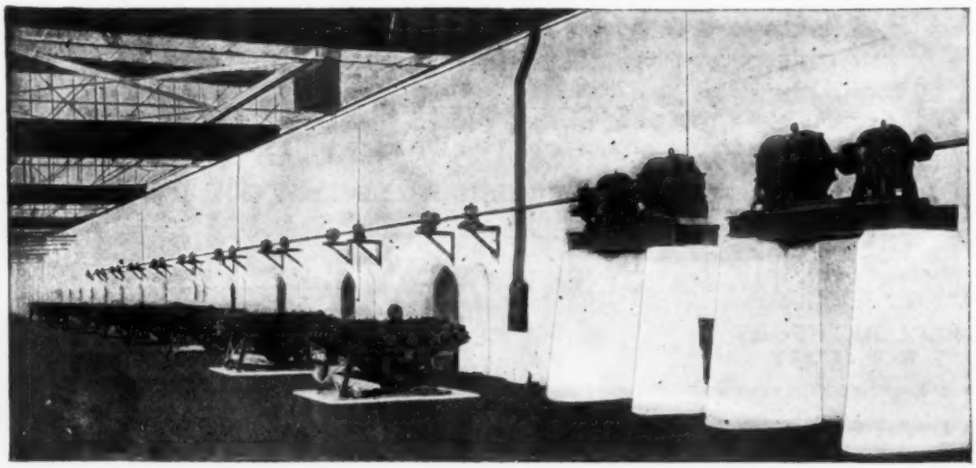
Hill Friction Clutches

Collar Oiling Bearings
and
Complete Power Transmission Machinery Equipments

Catalogs upon Request

Hill Friction Clutch Pulley
Smith Type
(Patented)

The Hill Clutch Co.
Cleveland, Ohio
New York Office, 50 Church Street



Here are two 100 H. P. Turbo-Gears driving the line shafts in the tin plate mill of one of the large steel companies. The speed reduction being 730 to 122 R. P. M.

Aside from the obvious advantages they get a transmission efficiency of 98%, a quiet, smooth-running, absolutely safe drive with no attention or adjustments required and no maintenance cost.

SOONER OR LATER—EVERYWHERE—FOR ALL DRIVES—THE

TURBO GEAR

FAST PATENTS

WRITE FOR BULLETIN 100—IT IS A NEW ONE

Number 3 of the series showing features of the design and construction of Turbo-Gears will appear in the January issue. Watch for it.

The Poole Engineering & Machine Company

Manufacturers of Gears and Power Transmission Machinery since 1843

Baltimore Maryland, U. S. A.

Boston.....53 State Street
Minneapolis..716 McKnight Building
Detroit, Mich..823 Dime Bank Bldg.
Seattle, Wash.....L. C. Smith Bldg.
Savannah, Ga....26 Bay Street, West

New York.....50 Church Street
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MORSE
SILENT CHAINS

MORSE CHAIN COMPANY ITHACA, NEW YORK

The Only 99% Efficient Power Transmission

Let MORSE Engineers Design Your New Drive

From ¼ H.P. to 5,000 H.P. THEY MAKE GOOD

Only by using MORSE CHAINS can you get the MOST out of your Machines and Motors

The MOST is little enough just now

POWERFUL SILENT ENDURING

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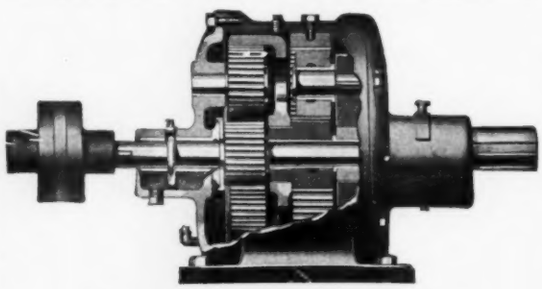

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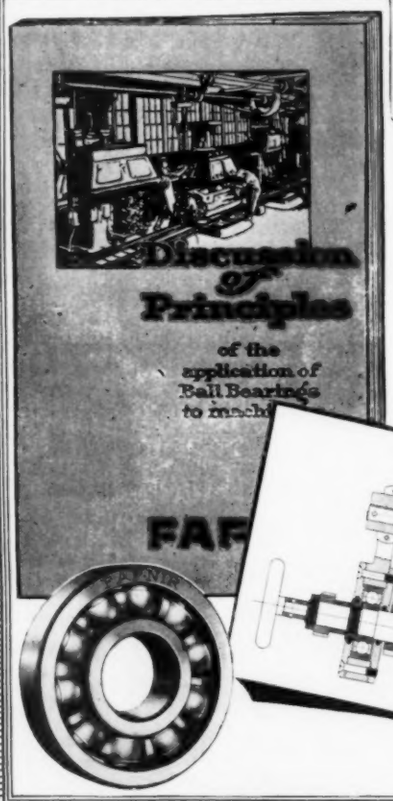

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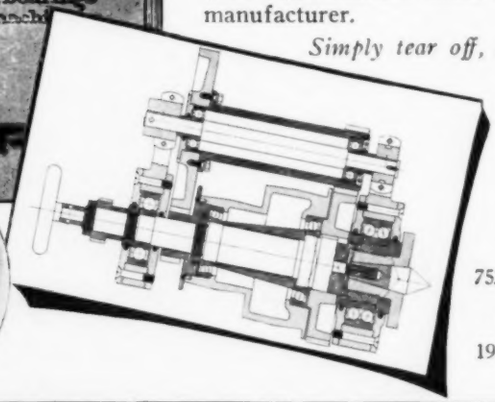

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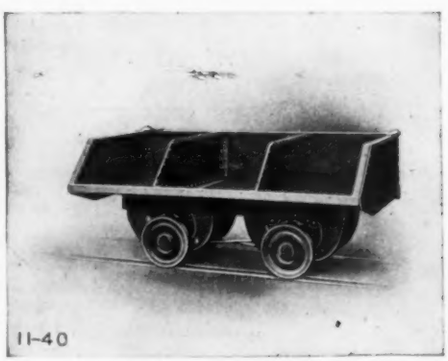

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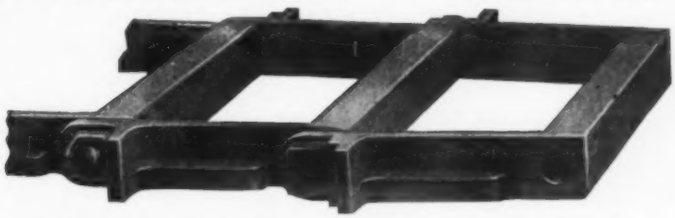

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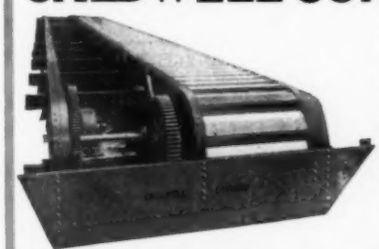

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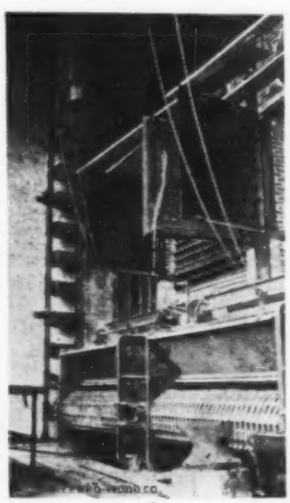

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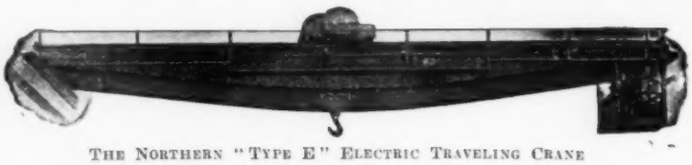

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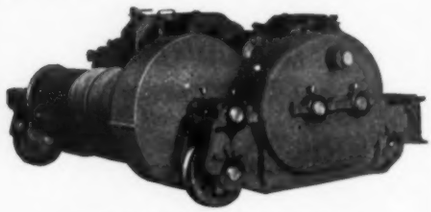

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cannot be improved either for firing the boiler or view of the load and is entirely unobstructed by piping, boom latticing or other obstructions. Another evidence that the designs of

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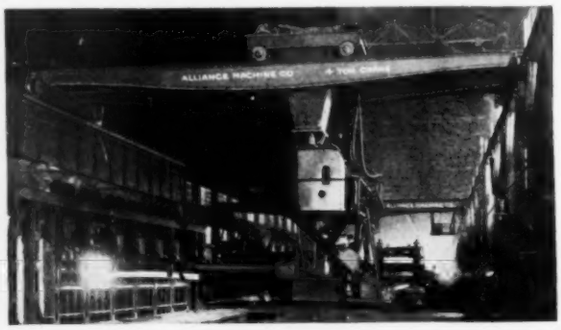

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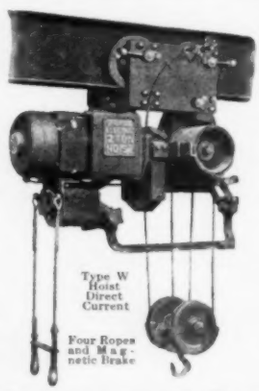

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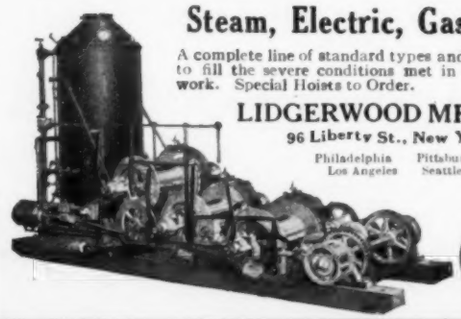

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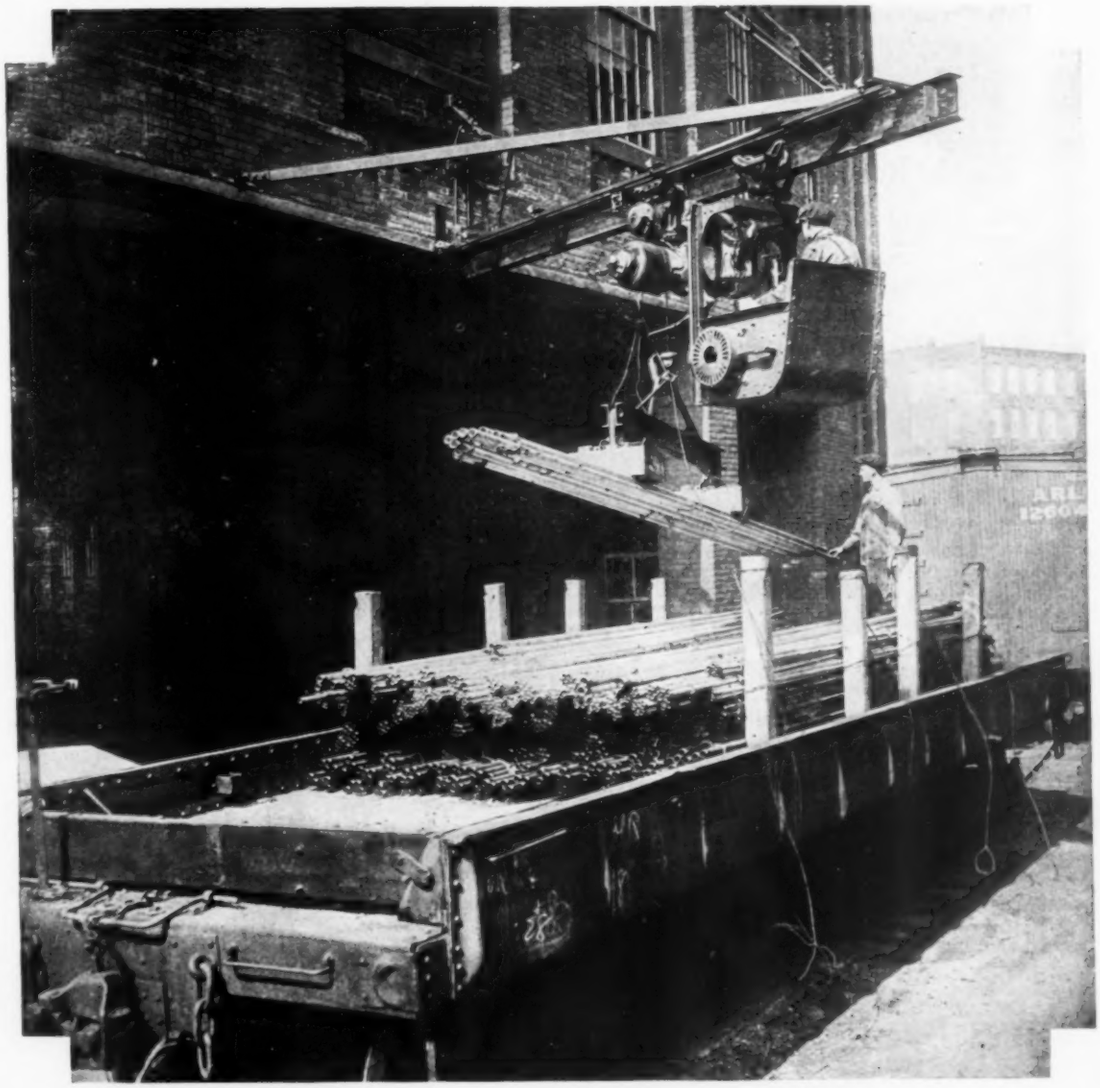

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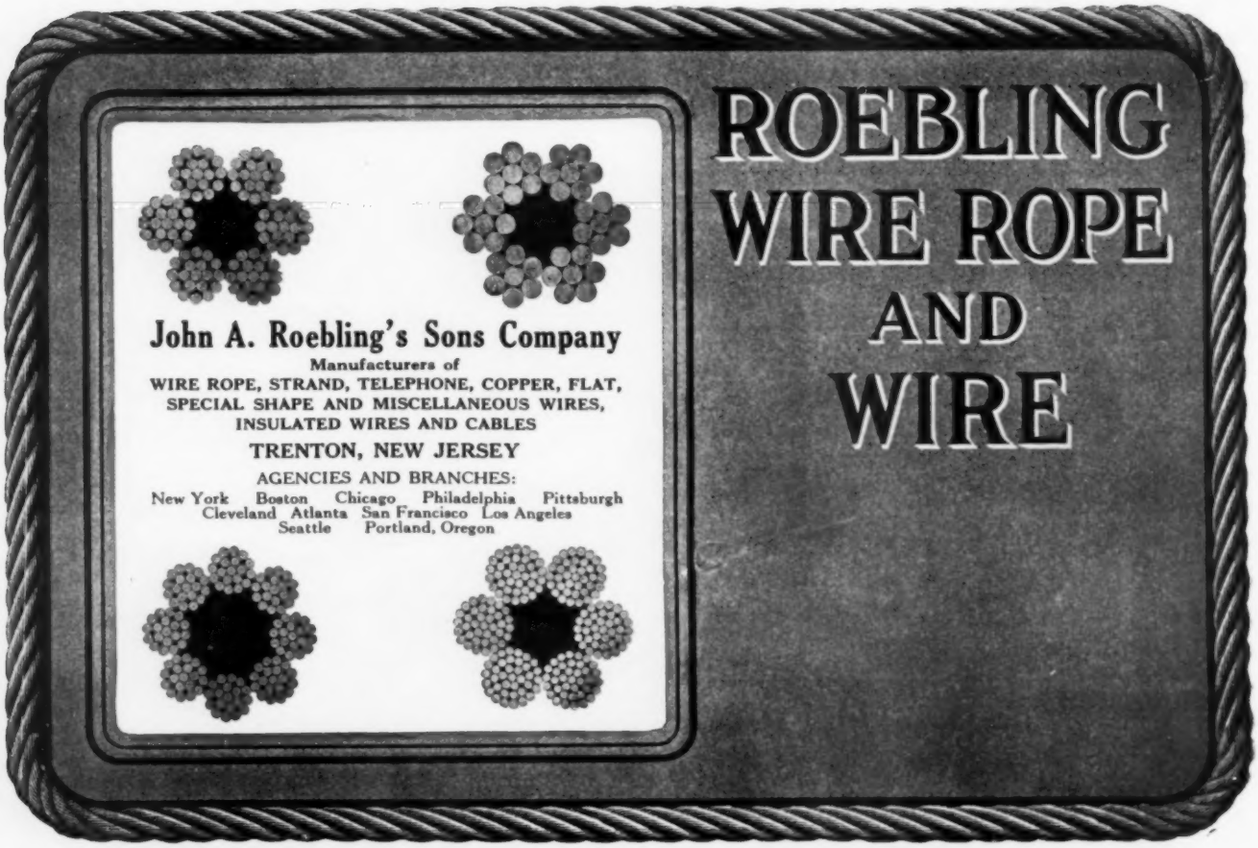

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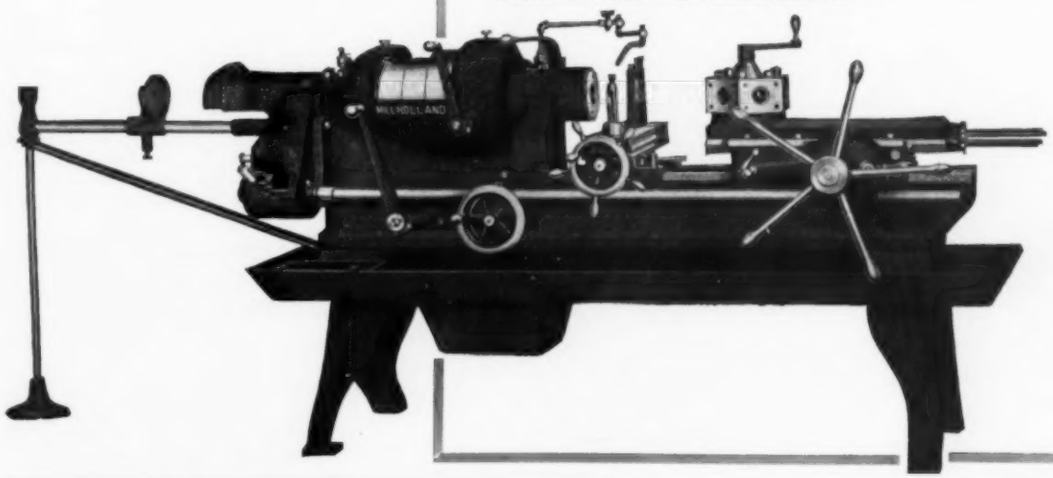

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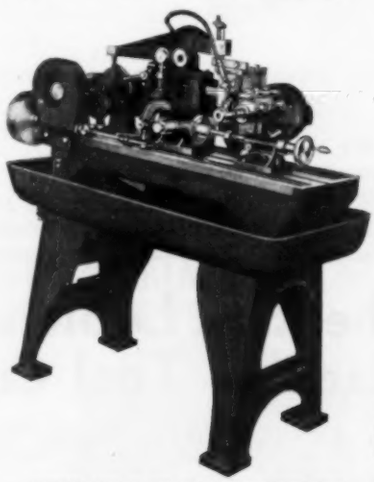

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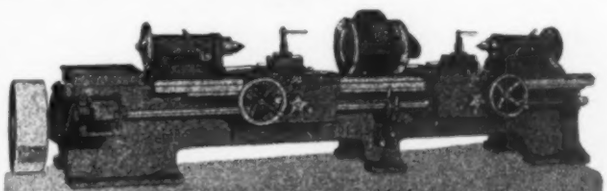

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HAVE for many years enjoyed a reputation for both productive capacity and service.

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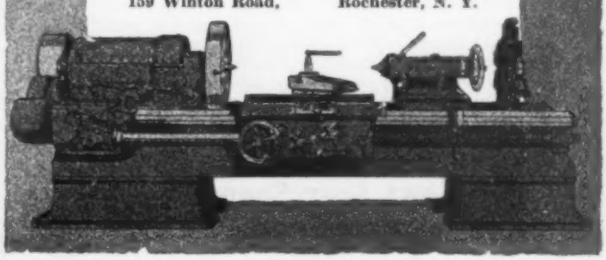

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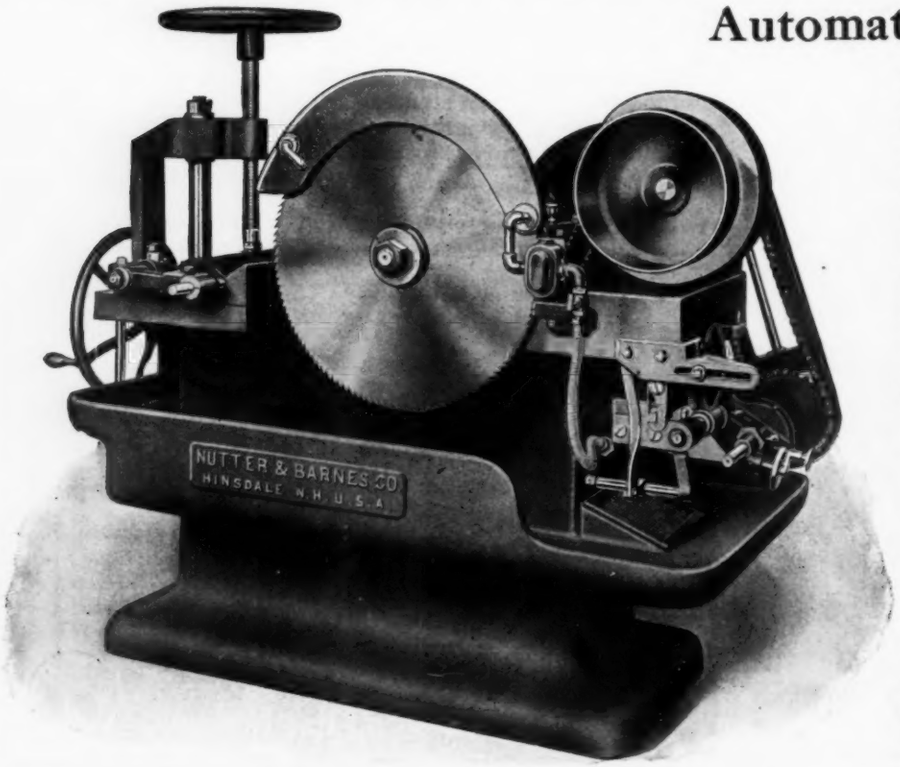

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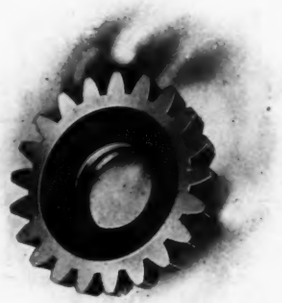

THE GEAR SHAPER CUTTER works on the molding-generating process and is ground all over after hardening, including the involute curves on the teeth which are generated. Strictly speaking, it is a laboratory product made in commercial quantities and sold at commercial prices. What is of greatest interest to you is the fact that you can buy Gear Shaper cutters year after year of the same high dependable grade of accuracy. We have a booklet, "The Gear Shaper Cutter," which will tell you more about this wonderful tool.

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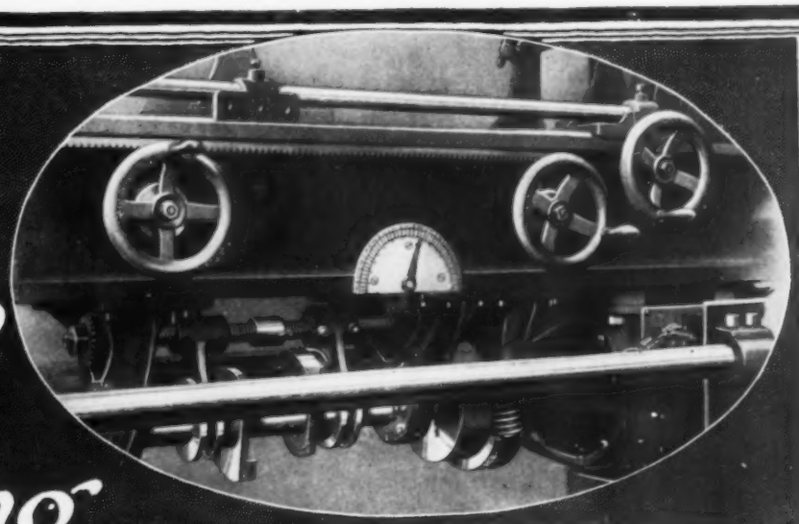
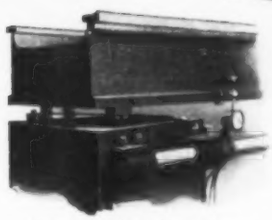
GTD

Finds the Balance While Running

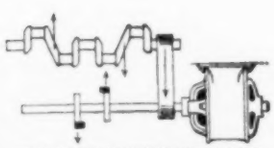




Left end of bed, showing supporting springs and micrometer vibration indicator

One man, operating a Type C Carwen Dynamic Balancing Machine, can measure the running unbalance in 100 armatures or crankshafts in an 8-hour day.

An ordinary workman, drilling or adding metal according to the balancing machine's readings, can put them in balance in about the same time.



MEASURES RUNNING UNBALANCE

The Carwen machine works so rapidly because it is *adjusted while running*. One hand-wheel locates the *plane* of unbalance; the other measures the *amount* of unbalance. By turning first one, then the other, the correct result is found in a few moments.

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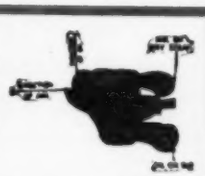

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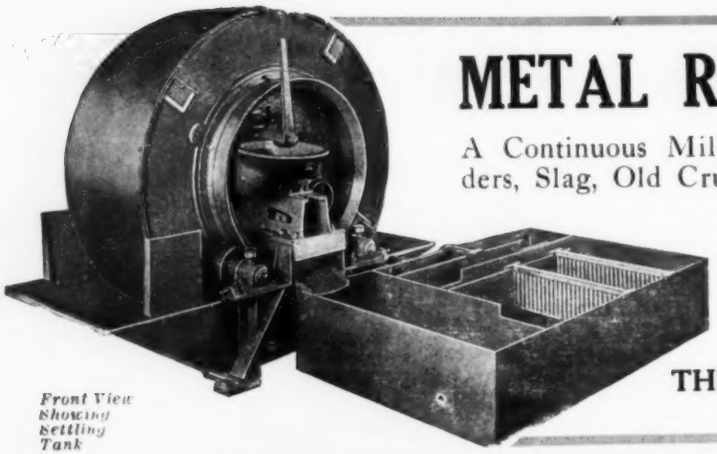

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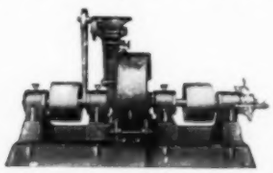

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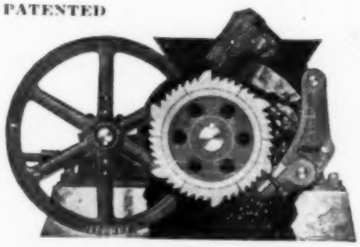

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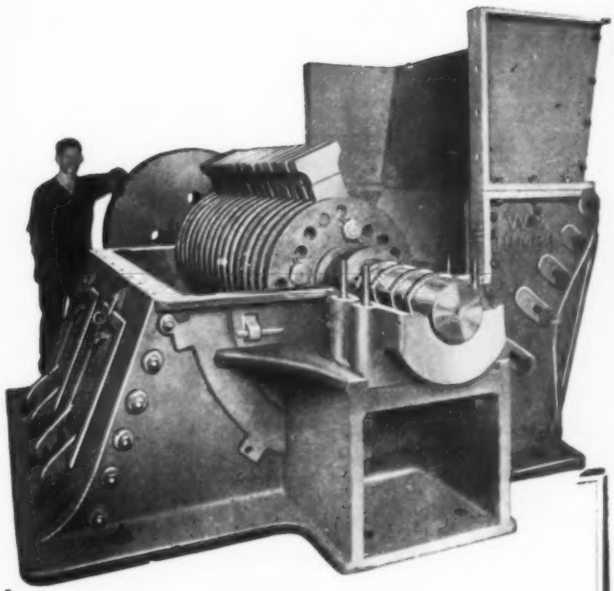

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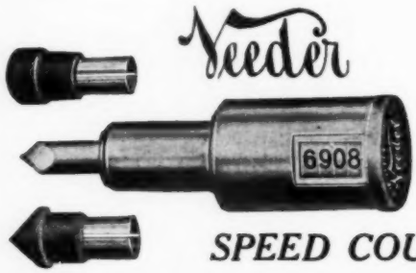

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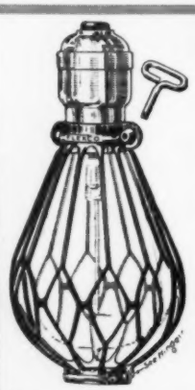

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The Journal of The American Society of Mechanical Engineers

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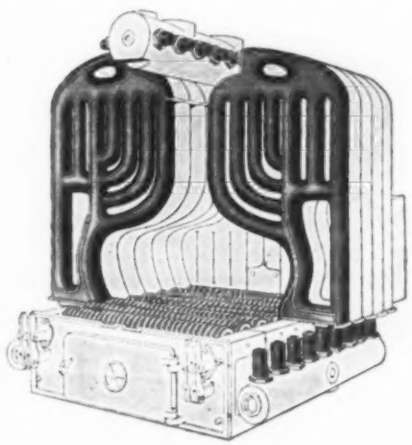

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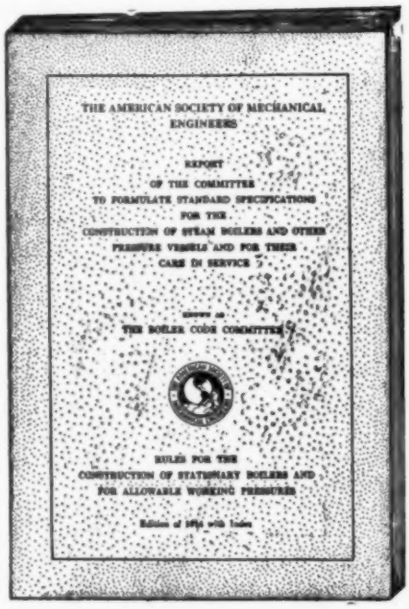
The Boiler Code



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A signal event for the boiler industry and one that means much to the field of power production in general was the completion of the Am. Soc. M. E. Boiler Code. This report, containing standard specifications for the construction, equipment and use of steam boilers, embodies the collective knowledge of the world's best experts. Its issuance by the Society marks a new era in the manufacture of steam boilers and inaugurates a movement of great importance for the protection of human life and property.

For the engineer, designer and student, the Boiler Code is invaluable as a treatise, covering the modern design and methods of construction of steam boilers and rules for determining the allowable working pressures for boilers in operation. It is used in many of our leading universities as a boiler text book.

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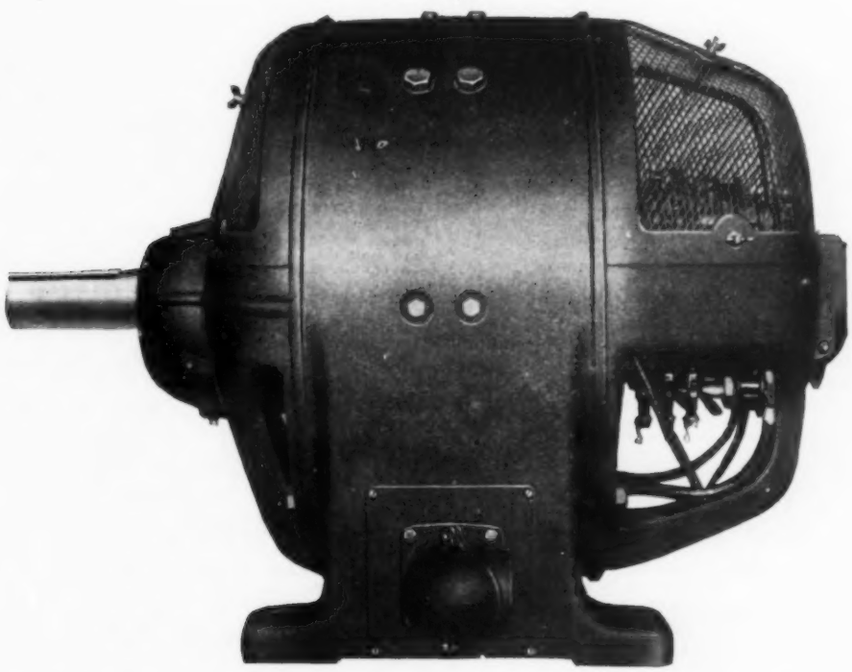

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(See Separators, Oil)

Grinding Machinery
Bauer Bros. Co.
* Brown Co., A. & F.
* Williams Patent Crusher & Pulverizer Co.

Grinding Machines, Floor
Builders Iron Foundry
* Royersford Fdry. & Mach. Co.

Grinding Machines, Cutter
Heald Machine Co.
Le Blond Machine Tool Co.

Grinding Machines, Cylindrical
Heald Machine Co.

Grinding Machines, Drill
Heald Machine Co.

Grinding Machines, Internal
Heald Machine Co.

Grinding Machines, Surface
Heald Machine Co.

Grinding Machines, Tool
Heald Machine Co.
Le Blond Machine Tool Co.

Gun and Motor Carriages
Morgan Engineering Co.

Gun Metal Finish
American Metal Treatment Co.

Hammers, Drop
* Alliance Machine Co.

Hammers, Steam
* Alliance Machine Co.
Buffalo Fdry. & Mach. Co.
Morgan Engineering Co.

Hangers, Shaft
* Brown Co., A. & F.
* Caldwell & Son Co., H. W.
* Chain Belt Co.
* Falls Clutch & Machinery Co.
* Hill Clutch Co.
Jeffrey Mfg. Co.
* Link-Belt Co.
* Royersford Fdry. & Mach. Co.
* Woods Sons Co., T. B.

Hardening
American Metal Treatment Co.

Head Gates
Holyoke Machine Co.

Heat Treating
American Metal Treatment Co.

Heaters, Feed Water (Closed)
* Erie City Iron Works
* National Pipe Bending Co.
Schutte & Koerting Co.

Heaters and Mixers, Water, Instantaneous
Manufacturing Equipment & Engrg. Co.

Heaters and Purifiers, Feed Water (Open)
* Erie City Iron Works
* National Pipe Bending Co.
* Springfield Boiler Co.
* Wickes Boiler Co.

Hoisting and Conveying Machinery
* Box & Co., Alfred
Brown Hoisting Machinery Co.
* Clyde Iron Works
Gifford-Wood Co.
* Hunt Co., Inc., C. W.
Jeffrey Mfg. Co.
* Lidgerwood Mfg. Co.
* Link-Belt Co.
Northern Engineering Works
Orton & Steinbrenner Co.
* Shepard Electric Crane & Hoist Co.

Hoists, Air
Northern Engineering Works
* Shepard Electric Crane & Hoist Co.

Hoists, Belt
* Clyde Iron Works
* Lidgerwood Mfg. Co.

Hoists, Chain
Box & Co., Alfred
* Ford Chain Block & Mfg. Co.
Northern Engineering Works
Yale & Towne Mfg. Co.

Hoists, Electric
* Alliance Machine Co.
Box & Co., Alfred
* Brown Hoisting Machinery Co.
* Clyde Iron Works
* General Electric Co.
* Hunt Co., Inc., C. W.
* Lidgerwood Mfg. Co.
* Link-Belt Co.
Northern Engineering Works
Orton & Steinbrenner Co.
* Shepard Electric Crane & Hoist Co.
Sprague Electric Works

Hoists, Friction
Eastern Machinery Co.

Hoists, Gas and Gasoline
* Lidgerwood Mfg. Co.
Otto Engine Mfg. Co.

Hoists, Head Gate
* Hunt Machine Co., Rodney

Hoists, Mine
* Lidgerwood Mfg. Co.

Hoists, Skip
* Brown Hoisting Machinery Co.
* Hunt Co., Inc., C. W.
* Lidgerwood Mfg. Co.
* Link-Belt Co.

Hoists, Steam
(See Engines, Hoisting)

Holders, Gas
* Wood & Co., R. D.

Hose, Air
* Goodrich Co., B. F.
Quaker City Rubber Co.
Sprague Electric Works

Hose, Linen
* Goodrich Co., B. F.

Hose, Metallic
* Johns-Manville Co., H. W.
Sprague Electric Works

Hose, Oil
* Goodrich Co., B. F.
Quaker City Rubber Co.

Hose, Rubber
* Goodrich Co., B. F.
Quaker City Rubber Co.

Hose, Steam
* Goodrich Co., B. F.
Quaker City Rubber Co.
Sprague Electric Works

Hose, Suction
* Goodrich Co., B. F.
Quaker City Rubber Co.

Hose Attachments (Couplings, Bands, Holders, Clamps, etc.)
* Goodrich Co., B. F.
Quaker City Rubber Co.

Hydrants, Fire
Ludlow Valve Mfg. Co.
* Wood & Co., R. D.

Hydraulic Jacks, Rams, Presses, Turbines, etc.
(See Jacks, Rams, Presses, Turbines, etc., Hydraulic)

Hydraulic Machinery
* Alliance Machine Co.
Holyoke Machine Co.
Mackintosh, Hemphill & Co.
Morgan Engineering Co.
* Wood & Co., R. D.

Hydrogen Gas
* International Oxygen Co.

Hydrokineters
Schutte & Koerting Co.

Hygrometers
Foxboro Co.
* Taylor Instrument Cos.

Ice Making Machinery
* De La Vergne Machine Co.
* Johns-Manville Co., H. W.
* Vilter Mfg. Co.

Ice Tools
* Caldwell & Son Co., H. W.
Gifford-Wood Co.

Impregnating Apparatus
Buffalo Fdry. & Mach. Co.

Indicator Posts
* Crane Co.
Ludlow Valve Mfg. Co.
* Wood & Co., R. D.

Indicators, CO_2
Bacharach Industrial Instrument Co.
Foxboro Co.

Indicators, Engine
Bacharach Industrial Instrument Co.
* Schaeffer & Budenberg Mfg. Co.

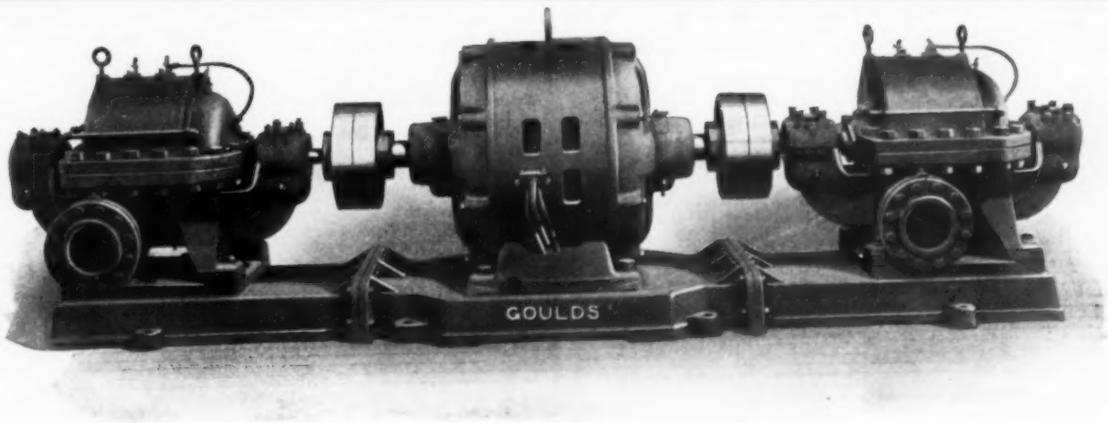
Indicators, Sight Flow
* Richardson-Phenix Co.

Indicators, Speed
Foxboro Co.
* Schaeffer & Budenberg Mfg. Co.
* Veeder Mfg. Co.
* Weston Electrical Instrument Co.

Industrial Railways
(See Railways, Industrial)

Ingot Strippers
* Alliance Machine Co.
Morgan Engineering Co.

Injectors
Lunkenheimer Co.
Schutte & Koerting Co.



FOR BOILER FEEDING AND BOILER WASHING

This outfit which consists of two Goulds Fig. 3300—1,000 gallon, 2-stage Centrifugal Pumps is installed in a large plant at Rochester, N. Y., where it serves the double purpose of an emergency boiler feed pump and boiler washing pump. When used for boiler washing, the pumps are arranged to discharge in parallel at a pressure of 150 lbs. When used for boiler feeding, they discharge in series at a pressure of 300 lbs. This is only one of the great number of uses for which

GOULDS PUMPS
FOR EVERY SERVICE

are installed in a surprisingly large number of Industrial and Power Plants over the entire country. Our line contains not only Centrifugal Pumps, but Triplex, Vacuum, Rotary, Air, Deep Well, Diaphragm, and pumps for many standard and special purposes. **BULLETINS ON REQUEST.**

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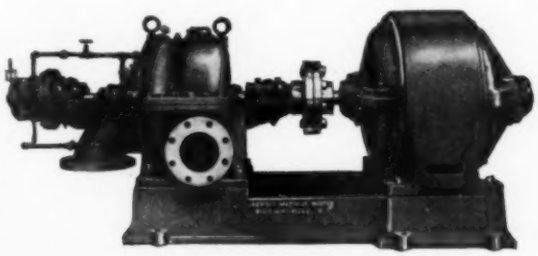
Main Office and Works: Seneca Falls, N. Y.

Branch Houses: Boston, New York, Philadelphia, Chicago

District Offices: Pittsburgh, Atlanta, Baltimore, Houston.



6" Horizontally Split Multi-Stage Pump

Centrifugal Pumps
Hydraulic Dredges
Steam Engines

MORRIS MACHINE WORKS

BALDWINSVILLE, N. Y., U. S. A.

Agencies in Principal Cities

SEE OUR DATA IN 1917 A.S.M.E. CONDENSED CATALOGUES OF MECHANICAL EQUIPMENT

1

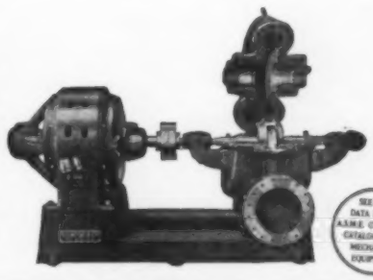
R. D. WOOD & CO.

ENGINEERS
IRON FOUNDERS
MACHINISTS

PHILADELPHIA, PA.

BUILDERS OF Gas Holders, Single and Multiple Lift; Gas Plants; Gas Producer Power Plants; Hydraulic Presses and Heavy Hydraulic Machinery; Pumping Engines. Centrifugal Pumping Plants; Water Works Appliances; Steel Tanks; Sugar House Apparatus; Heavy Special Machinery; Theisen Washers.

MANUFACTURERS OF C. I. Pipe, Gas Works Apparatus, Centrifugal Pumps, Hydraulic Tools of all description, Hydrants and Valves, Gas Producers.



SEE OUR DATA IN 1917 A.S.M.E. CONDENSED CATALOGUES OF MECHANICAL EQUIPMENT

Instruments, Electrical Measuring
* General Electric Co.
* Taylor Instrument Cos.
* Westinghouse Elec. & Mfg. Co.
* Weston Electrical Instrument Co.

Instruments, Physical
* Taylor Instrument Cos.

Instruments, Recording
* Ashton Valve Co.
Bacharach Industrial Instrument Co.
* Bailey Meter Co.
Builders Iron Foundry
Foxboro Co.
* General Electric Co.
* Precision Instrument Co.
* Schaeffer & Budenberg Mfg. Co.
* Taylor Instrument Cos.
* Westinghouse Elec. & Mfg. Co.
Yarnall-Waring Co.

Insulating Materials (Elec.)
* American Vulcanized Fibre Co.
Johns-Manville Co., H. W.

Insulating Materials (Heat and Cold)
* Johns-Manville Co., H. W.
* Magnesia Assoc. of America

Irrigation Systems
* Spray Engineering Co.

Jigs and Fixtures
Cowdrey Machine Works, C. H.

Joints, Expansion
* Crane Co.
Lunkenheimer Co.
* Pittsburgh Valve Fndry. & Const. Co.
Power Specialty Co.
Walworth Mfg. Co.

Joints, Flanged Pipe
* Crane Co.
* Pittsburgh Valve Foundry & Construction Co.
Walworth Mfg. Co.

Kettles
Buffalo Fdry. & Mach. Co.

Kettles, Soda
Manufacturing Equipment & Engrg. Co.

Ladles
Connelly Boiler Co., D.
Northern Engineering Works

Lamp Guards (Electric)
* Flexible Steel Lacing Co.

Lamps, Incandescent
* General Electric Co.
* Johns-Manville Co., H. W.
* Westinghouse Elec. & Mfg. Co.

Land-Clearing Machinery
* Clyde Iron Works

Lathe Attachments
Le Blond Machine Tool Co.

Lathes
Bridgeport Machine Tool Wks.
Builders Iron Foundry
*Harris-Corliss Engine & Machine Co.

Lathes, Automatic
* Jones & Lamson Machine Co.

Lathes, Axle
Bridgeport Machine Tool Wks.

Lathes, Brass
* Warner & Swasey Co.

Lathes, Chucking
* Jones & Lamson Machine Co.

Lathes, Engine
Bridgeport Machine Tool Wks.
Le Blond Machine Tool Co.
Wickes Bros.

Lathes, Journal Truing
Bridgeport Machine Tool Wks.

Lathes, Speed
Le Blond Machine Tool Co.

Lathes, Turret
* Jones & Lamson Machine Co.
* Millholland Machine Co., W. K.
* Warner & Swasey Co.

Leather Belting, Packing, etc.
(See Belting, Packing, etc., Leather)

Leather, Friction
* Schieren Co., Chas. A.

Leathers, Pump
* Schieren Co., Chas. A.

Lightning Arresters
* General Electric Co.

Lining, Brake
* Johns-Manville Co., H. W.

Lining, Furnace
* Best, W. N.
* Johns-Manville Co., H. W.

Lining, Stack
* Johns-Manville Co., H. W.

Liquid Fuel Equipment
* Best, W. N.

Loaders, Wagon
* Chain Belt Co.
Gifford-Wood Co.
Jeffrey Mfg. Co.
* Link-Belt Co.

Lockers, Metal
Manufacturing Equipment & Engrg. Co.

Locomotives, Electric
* General Electric Co.
* Hunt Co., Inc., C. W.
Jeffrey Mfg. Co.
* Westinghouse Elec. & Mfg. Co.

Logging Machinery
* Clyde Iron Works
* Lidgerwood Mfg. Co.

Lubricants
* Royersford Fdry. & Mach. Co.
* Texas Co.

Lubricators, Cylinder
Crescent Mfg. Co.
* Greene, Tweed & Co.
Lunkenheimer Co.
* Richardson-Phenix Co.

Lubricators, Force-Feed
* Greene, Tweed & Co.
Lunkenheimer Co.
* Pickering Governor Co.
* Richardson-Phenix Co.

Lubricators, Hydrostatic
Crescent Mfg. Co.
Lunkenheimer Co.

Machine Work
* Brown Co., A. & F.
Builders Iron Foundry
* Caldwell & Son Co., H. W.
Cowdrey Machine Wks., C. H.
* Hill Clutch Co.
* Lammert & Mann
* Link-Belt Co.
Mesta Machine Co.
Weimer Machine Works Co.
* Wood & Co., R. D.

Machinery
(Is classified under the headings descriptive of character thereof)

Magnesia Products
* Magnesia Assoc. of America

Mechanical Draft Apparatus
* Green Fuel Economizer Co.

Mechanical Stokers
(See Stokers)

Metal Equipment
Manufacturing Equipment & Engine Co.

Metal Reclaiming Mills
(See Mills, Metal Reclaiming)

Metal Treating
* American Metal Treatment Co.

Metals, Perforated
Hendrick Mfg. Co.

Meters, Air and Gas
Bacharach Industrial Instrument Co.
* Bailey Meter Co.
Builders Iron Foundry
Foxboro Co.
* General Electric Co.

Meters, Electric
* General Electric Co.
* Westinghouse Elec. & Mfg. Co.

Meters, Feed Water
* Bailey Meter Co.
Builders Iron Foundry
Foxboro Co.
Yarnall-Waring Co.

Meters, Steam
* Bailey Meter Co.
Builders Iron Foundry
Foxboro Electric Co.
* General Electric Co.

Meters, V-Notch
* Bailey Meter Co.
Yarnall-Waring Co.

Meters, Venturi
Builders Iron Foundry
* National Meter Co.

Meters, Water
* National Meter Co.

Micrometers
* Greenfield Tap & Die Corp.

Milling Attachments
Le Blond Machine Tool Co.

Milling Machines, Automatic
* Bilton Machine Tool Co.

Milling Machines, Plain
* Bilton Machine Tool Co.
Le Blond Machine Tool Co.
* Warner & Swasey Co.

Milling Machines, Universal
Le Blond Machine Tool Co.

Mills, Ball
* Lehigh Car, Wheel & Axle Works

Mills, Blooming and Slabbing
Mackintosh, Hemphill & Co
Mesta Machine Co.

Mills, Cinder
Standard Equipment Co.

Mills, Grinding
Bauer Bros. Co.
* Williams Patent Crusher & Pulverizer Co.

Mills, Metal Reclaiming
Standard Equipment Co.

Mills, Sheet and Plate
Mackintosh, Hemphill & Co.
Mesta Machine Co.

Mills, Structural, Rail and Bar
Mackintosh, Hemphill & Co.
Mesta Machine Co.

Mills, Sugar Cane
Mesta Machine Co.

Mixers, Clay, Fertilizer, etc.
* Williams Patent Crusher & Pulverizer Co.

Mixers, Concrete
* Chain Belt Co.

Monorail Systems
(See Tramrail Systems, Overhead)

Motion Recorders
Foxboro Co.

Motor-Generators
* General Electric Co.
* Westinghouse Elec. & Mfg. Co.

Motors, Electric
Electro Dynamic Co.
* General Electric Co.
* Shepard Electric Crane & Hoist Co.
Sprague Electric Works
* Westinghouse Elec. & Mfg. Co.

Nozzles, Aerating
* Spray Engineering Co.

Nozzles, Blast
Schutte & Koerting Co.

Nozzles, Sand and Air
Lunkenheimer Co.

Nozzles, Spray
Schutte & Koerting Co.
* Spray Engineering Co.

Odometers
* Veeder Mfg. Co.

Oil and Grease Cups
* Crane Co.
Crescent Mfg. Co.
Lunkenheimer Co.

Oil Burners, Engines, Filters, Pumps, Separators, etc.
(See Burners, Engines, Filters, Pumps, Separators, etc. Oil)

Oil Burning Equipment
* Best, W. N.
Schutte & Koerting Co.

Oil Filtering Systems
* Richardson-Phenix Co.

Oil Storage Systems
* Richardson-Phenix Co.

Oil Tanks
Graver Tank Works, Wm.
* Richardson-Phenix Co.
* Scaife & Sons Co., Wm. B.

Oilers, Sight Feed
Lunkenheimer Co.
* Richardson-Phenix Co.

Oilers, Telescopic
* Richardson-Phenix Co.

Oiling Devices
Lunkenheimer Co.
* Richardson-Phenix Co.

Oiling Systems
Lunkenheimer Co.
* Richardson-Phenix Co.

Oils, Fuel
* Texas Co.

Oils, Lubricating
* Texas Co.

Ore Handling Machinery
* Brown Hoisting Machinery Co.
* Hunt Co., Inc., C. W.
Jeffrey Mfg. Co.
* Link-Belt Co.
Toledo Bridge & Crane Co.

Ovens, Core
* Lane Co., H. M.

Oxygen Gas
* International Oxygen Co.

Packing, Asbestos
* Johns-Manville Co., H. W.

Packing, Hydraulic
* Goodrich Co., B. F.
* Greene, Tweed & Co.
* Johns-Manville Co., H. W.
Power Specialty Co.
Quaker City Rubber Co.
* Schieren Co., Chas. A.

Packing, Leather
* Schieren Co., Chas. A.

Packing, Metallic
* Johns-Manville Co., H. W.
Power Specialty Co.

Packing, Rod (Piston and Valve)
* Goodrich Co., B. F.
* Greene, Tweed & Co.
* Jenkins Bros.
* Johns-Manville Co., H. W.
Power Specialty Co.
Quaker City Rubber Co.

Packing, Rubber
* Goodrich Co., B. F.
* Jenkins Bros.
* Johns-Manville Co., H. W.
Quaker City Rubber Co.

Packing, Sheet
* American Vulcanized Fibre Co.
* Goodrich Co., B. F.
* Jenkins Bros.
* Johns-Manville Co., H. W.
Quaker City Rubber Co.

Paint, Metal
* Johns-Manville Co., H. W.

Pans, Vacuum
Buffalo Fdry. & Mach. Co.

Paper Machinery
Holyoke Machine Co.
Moore & White Co.

Pasteurizers
* Vilter Mfg. Co.

Pencils
American Lead Pencil Co.

Penstocks
Hunt Machine Co., Rodney

Perforated Metals
(See Metals, Perforated)

Petroleum Products
* Texas Co.

Pickling Machines
Mesta Machine Co.

Pile Drivers
* Clyde Iron Works
* Lidgerwood Mfg. Co.

Pinions, Rolling Mill
Mackintosh, Hemphill & Co.
Mesta Machine Co.

Pinions, Rawhide
New Process Gear Corp.

*Catalogue data of firms marked * appear in the A. S. M. E. Condensed Catalogues of Mechanical Equipment, 1917 Volume*

Some Recent Papers on Water Power

Title.	Cat. No.	Price.
Water Power Development of Hannawa Falls.....W. C. Johnson	919	.30
Analysis of the Commercial Value of Water Power per Horse Power, A. F. Nagle	967	.20
Computation of the Value of Water Power Chas. T. Main	1057	.20
Improvement of the Tenn. River and Power Installation of Chattanooga and Tenn. R. H. Power Co., at Hale Bar, Tenn.....Thos. E. Murray	1105	.20
Development of a Modern Water Wheel Governor.....Mark A. Replogle	1110	.20
Regulation of High Pressure Water Wheels for Power Transmission Plants.....Geo. J. Henry, Jr.	1111	.20
Speed Regulation of Water Power Plant John Sturgess	1112	.10
Testing of Water Wheels after Installation C. M. Allen	1277	.20
Surge Tank in Water Power Plants R. D. Johnson	1204	.40
Hydrostatic Chord.....R. D. Johnson	1284	.10
On the Control of Surges in Water Conduit W. F. Durand	1353	.40
Speed Regulation in Hydro-Electric Plants Wm. F. Uhl	1354	.40
Power Development at the High Dam between Minneapolis and St. Paul A. F. Meyer	1437	.20
Damages for Loss of Water Power F. W. Dean	1463	.10
Unique Hydraulic Power Plant at the Henry Ford Farms....M. A. Replogle	1517	.20

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OF

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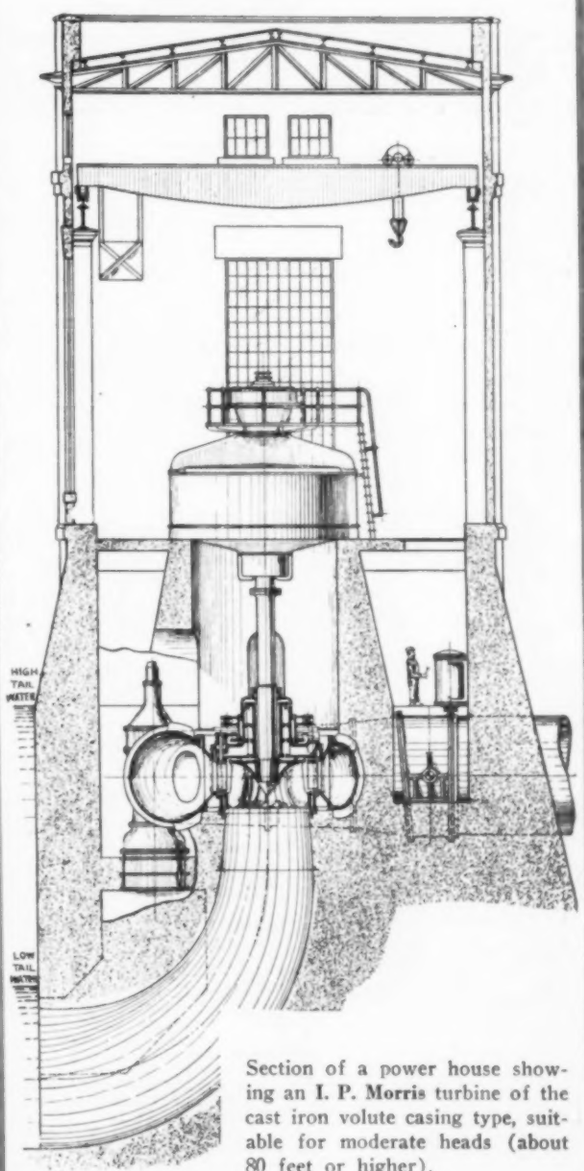
Hydraulic Turbines



Section of a power house showing an I. P. Morris turbine of the cast iron volute casing type, suitable for moderate heads (about 80 feet or higher).

View shows 13,200 horse-power turbine in the Bridgewater Station of the Western Carolina Power Co. Head 115 feet.

SEE OUR DATA IN 1917 A.S.M.E. CONDENSED CATALOGUES OF MECHANICAL EQUIPMENT

Pipe, Cast Iron
Builders Iron Foundry
* Central Foundry Co.

Pipe, Riveted Steel
Connelly Boiler Co., D.
Graver Tank Works, Wm.
* Hunt Machine Co., Rodney
* Springfield Boiler Co.

Pipe, Soil
* Central Foundry Co.

Pipe, Steel
* Crane Co.
Walworth Mfg. Co.

Pipe, Welded
* Crane Co.
* Pittsburgh Valve Fdry. & Const. Co.

Pipe, Wood
* Hunt Machine Co., Rodney

Pipe, Wrought Iron
* Crane Co.
Walworth Mfg. Co.

Pipe Coils, Covering, Cutters, Fittings, Joints, etc.
(See Coils, Covering, Cutters, Fittings, Joints, etc., Pipe)

Pipe Cutting and Threading Machines
* Crane Co.
* Greenfield Tap & Die Corp.

Pipe Joint Clamps
(See Clamps, Pipe Joint)

Piping, Power
* Crane Co.
* National Pipe Bending Co.
* Pittsburgh Valve Foundry & Construction Co.
Walworth Mfg. Co.

Plate Metal Work
(See Steel Plate Construction)

Polishing Machinery
Builders Iron Foundry
* Royersford Fdry. & Mach. Co.

Poppet Valve Engines
(See Engines, Steam, Poppet Valve)

Pots, Caustic
Buffalo Fdry. & Mach. Co.

Powdered Coal Equipment (for Boiler and Metallurgical Furnaces)
* Lehigh Car, Wheel & Axle Works
Locomotive Pulverized Fuel Co.

Power Transmission Machinery
* Brown Co., A. & F.
* Caldwell & Son Co., H. W.
* Chain Belt Co.
Eastern Machinery Co.
* Falls Clutch & Machinery Co.
Hill Clutch Co.
Holyoke Machine Co.
* Hunt Machine Co., Rodney
Jeffrey Mfg. Co.
* Link-Belt Co.
Mesta Machine Co.
Moore & White Co.
* Morse Chain Co.
Poole Engrg. & Mach. Co.
* Royersford Fdry. & Mach. Co.
* Wood's Sons Co., T. B.

Presses, Foot
* Royersford Fdry. & Mach. Co.

Presses, Forging (Steam-Hydraulic)
Mesta Machine Co.
* Wood & Co., R. D.

Presses, Hydraulic
* Alliance Machine Co.
* Falls Clutch & Machinery Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
* Wood & Co., R. D.

Presses, Punching and Trimming
* Royersford Fdry. & Mach. Co.

Pressure Gages, Regulators, etc.
(See Gages, Regulators, etc., Pressure)

Producers, Gas
* De La Vergne Machine Co.
Otto Engine Mfg. Co.
Smith Gas Engineering Co.
* Westinghouse Elec. & Mfg. Co.
* Wood & Co., R. D.

Propellers
* Morris Machine Co.

Pulleys, Iron
* Brown Co., A. & F.
* Chain Belt Co.
* Caldwell & Son Co., H. W.
* Falls Clutch & Machinery Co.
Gifford-Wood Co.
* Hill Clutch Co.
Holyoke Machine Co.
Jeffrey Mfg. Co.
* Link-Belt Co.
* Wood's Sons Co., T. B.

Pulleys, Paper
Rockwood Mfg. Co.

Pulleys, Steel
* Caldwell & Son Co., H. W.

Pulleys, Wood
* Caldwell & Son Co., H. W.

Pulverized Fuel Feeders
(See Feeders, Pulverized Fuel)

Pulverizers
* Brown Co., A. & F.
Jeffrey Mfg. Co.
* Lehigh Car, Wheel & Axle Works
* Williams Patent Crusher & Pulverizer Co.

Pump Governors, Valves, etc.
(See Governors, Valves, etc., Pumps)

Pumping Engines
(See Engines, Pumping)

Pumps, Air
Goulds Mfg. Co.
Mesta Machine Co.
* Westinghouse Elec. & Mfg. Co.

Pumps, Boiler Feed
Goulds Mfg. Co.

Pumps, Centrifugal
Goulds Mfg. Co.
* Hunt Machine Co., Rodney
* Lammert & Mann
* Morris Co., I. P.
* Morris Machine Works
* Westinghouse Elec. & Mfg. Co.
* Wood & Co., R. D.

Pumps, Deep Well
Goulds Mfg. Co.
* Morris Machine Works

Pumps, Dredging
* Morris Machine Works
* Wood & Co., R. D.

Pumps, Dry Vacuum
(See Pumps, Vacuum)

Pumps, Electric
Goulds Mfg. Co.
* Morris Machine Works
* Wood & Co., R. D.

Pumps, Hand
Goulds Mfg. Co.

Pumps, Hydraulic Pressure
Goulds Mfg. Co.
* Morris Machine Works
* Wood & Co., R. D.

Pumps, Oil
Goulds Mfg. Co.
Lunkenheimer Co.
* Richardson-Phenix Co.
* Wood & Co., R. D.

Pumps, Oil, Force-Feed
* Greene, Tweed & Co.
Lunkenheimer Co.
* Pickering Governor Co.
* Richardson-Phenix Co.

Pumps, Power
Goulds Mfg. Co.
Holyoke Machine Co.
* Wood & Co., R. D.

Pumps, Rotary
Goulds Mfg. Co.
Holyoke Machine Co.
* Hunt Machine Co., Rodney
* Lammert & Mann

Pumps, Self-Measuring
* Richardson-Phenix Co.

Pumps, Sump
Goulds Mfg. Co.
* Morris Machine Works
* Wood & Co., R. D.

Pumps, Tank
Goulds Mfg. Co.
* Wood & Co., R. D.

Pumps, Turbine
* General Electric Co.
* Morris Machine Works
* Westinghouse Elec. & Mfg. Co.
* Wood & Co., R. D.

Pumps, Vacuum
Buffalo Fdry. & Mach. Co.
Goulds Mfg. Co.
* Lammert & Mann
Mesta Machine Co.

Punches, Hydraulic
* Alliance Machine Co.
Morgan Engineering Co.
* Wood & Co., R. D.

Punches, Power
* Royersford Fdry. & Mach. Co.

Punches, Multiple
Mackintosh, Hemphill & Co.
* Wood & Co., R. D.

Punches and Dies
* Royersford Fdry. & Mach. Co.

Punching and Shearing Machines
* Alliance Machine Co.
Morgan Engineering Co.
* Royersford Fdry. & Mach. Co.
Wickes Bros.
* Wood & Co., R. D.

Purifying and Softening Systems, Water
Graver Tank Works, Wm.
* Scaife & Sons Co., Wm. B.

Pyrometers, Electric
Foxboro Co.
* Schaeffer & Budenberg Mfg. Co.
* Taylor Instrument Cos.

Pyrometers, Radiation
* Taylor Instrument Cos.

Racks, Cut
* James Mfg. Co., D. O.

Racks, Storage, Metal
Manufacturing Equipment & Engrg. Co.

Radiators, Steam and Water
* Smith Co., H. B.
Walworth Mfg. Co.

Railways, Cable and Automatic
* Hunt Co., Inc., C. W.

Railways, Industrial
* Hunt Co., Inc., C. W.
* Link-Belt Co.

Rams, Hydraulic
Goulds Mfg. Co.

Reamers
* Greenfield Tap & Die Corp.

Reamers, Adjustable and Expansion
Kelly Reamer Co.

Receivers, Air
Graver Tank Works, Wm.
* Scaife & Sons Co., Wm. B.

Recording Instruments
(See Instruments, Recording)

Refrigerating Machinery
* De La Vergne Machine Co.
* Johns-Manville Co., H. W.
* Vilter Mfg. Co.
* Westinghouse Elec. & Mfg. Co.

Refuse Destructors
(See Destructors, Refuse)

Regulators, Blowers
Davis Regulator Co., G. M.
* Foster Engineering Co.

Regulators, Damper
Davis Regulator Co., G. M.
* Westinghouse Elec. & Mfg. Co.

Regulators, Electric
* General Electric Co.

Regulators, Feed Water
* Almy Water Tube Boiler Co.

Regulators, Flow (Steam)
Davis Regulator Co., G. M.
Schutte & Koerting Co.

Regulators, Pressure
Davis Regulator Co., G. M.
* Foster Engineering Co.
Golden-Anderson Valve Specialty Co.
* Taylor Instrument Cos.

Regulators, Pump
(See Governors, Pump)

Regulators, Temperature
Foxboro Co.
Sarco Co., Inc.
* Taylor Instrument Cos.

Regulators, Time
Foxboro Co.

Repairs, Emergency
* Harris-Corliss Engine & Machine Co.

Reservoirs, Aerating
* Spray Engineering Co.

Retorts, Acid
Buffalo Fdry. & Mach. Co.

Revolution Counters
(See Counters, Revolution)

Rings, Weldless Steel
Hay-Budden Mfg. Co.

Riveters, Hydraulic
* Alliance Machine Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
* Wood & Co., R. D.

Riveting Machines
* Bilton Machine Tool Co.

Roller Bearings
(See Bearings, Boiler)

Rolling Mill Machinery
* Alliance Machine Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.

Rolls, Bending
Wickes Bros.

Rolls, Forging
Mesta Machine Co.

Rolls, Sand, Chilled and Steel
Mackintosh, Hemphill & Co.
Mesta Machine Co.

Rolls, Rubber
* Goodrich Co., B. F.

Roofing
* Johns-Manville Co., H. W.
* Texas Co.

Roofing, Asbestos
* Johns-Manville Co., H. W.

Rope Drives
* Brown Co., A. & F.
* Caldwell & Son Co., H. W.
* Falls Clutch & Machinery Co.
* Hill Clutch Co.
Jeffrey Mfg. Co.
* Link-Belt Co.
* Wood's Sons Co., T. B.

Rope, Hoisting
* Clyde Iron Works
* Hunt Co., Inc., C. W.
* Roebling's Sons Co., John A.

Rope, Transmission
* Caldwell & Son Co., H. W.
* Hunt Co., Inc., C. W.
* Link-Belt Co.
* Roebling's Sons Co., John A.

Rope, Wire
* Clyde Iron Works
* Roebling's Sons Co., John A.

Rubber Goods, Mechanical
* Goodrich Co., B. F.
* Jenkins Bros.
Quaker City Rubber Co.

Sand Blast Apparatus
* De La Vergne Machine Co.
Lunkenheimer Co.

*Catalogue data of firms marked * appear in the A. S. M. E. Condensed Catalogues of Mechanical Equipment, 1917 Volume*

The Big Issue of the Year

Reserve your space now for the January number of The Journal of the A. S. M. E. in which will be reported entire the Annual Meeting of the Society

Advertising Forms
Close Dec. 12

Saw Mill Machinery
Wickes Bros.

Saw and Cutter Sharpeners
Nutter & Barnes Co.

Sawing Machines, Metal
Nutter & Barnes Co.

Screens, Perforated Metal
Hendrick Mfg. Co.

Screens, Revolving
* Caldwell & Son Co., H. W.
* Chain Belt Co.
Gifford-Wood Co.
Hendrick Mfg. Co.
Jeffrey Mfg. Co.
* Link-Belt Co.
* Williams Patent Crusher & Pulverizer Co.

Screens, Shaking
* Caldwell & Son Co., H. W.
* Chain Belt Co.
Gifford-Wood Co.
Hendrick Mfg. Co.
Jeffrey Mfg. Co.
* Link-Belt Co.
* Williams Patent Crusher & Pulverizer Co.

Screens, Traveling
* Chain Belt Co.
* Link-Belt Co.

Screw Cutting Dies
(See Dies, Thread Cutting)

Screw Machines, Hand
* Jones & Lamson Mach. Co.
* Millholland Machine Co., K.W.
* Warner & Swasey Co.

Screw Machine Products
* Millholland Machine Co., K.W.

Screw Plates
* Greenfield Tap & Die Corpn.

Screw Steel
* Union Drawn Steel Co.

Separators, Ammonia
* De La Vergne Machine Co.

Separators, Oil
* Crane Co.
* De La Vergne Machine Co.
* National Pipe Bending Co.

Separators, Steam
* Crane Co.
* National Pipe Bending Co.
Nightingale & Childs Co.
* Pittsburgh Valve Fdry. & Const. Co.

Shafting
* Brown Co., A. & F.
* Caldwell & Son Co., H. W.
* Chain Belt Co.
Cumberland Steel Co.
* Falls Clutch & Machinery Co.
* Hill Clutch Co.
Holyoke Machine Co.
* Union Drawn Steel Co.
* Woods Sons Co., T. B.

Shapes, Cold Drawn Steel
* Union Drawn Steel Co.

Shears, Alligator
Mesta Machine Co.
Morgan Engineering Co.

Shears, Hydraulic
* Alliance Machine Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
* Wood & Co., R. D.

Shears, Plate
* Alliance Machine Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
* Wood & Co., R. D.

Sheaves, Rope
* Brown Co., A. & F.
* Caldwell & Son Co., H. W.
* Clyde Iron Works
* Falls Clutch & Machinery Co.
* Hill Clutch Co.
Jeffrey Mfg. Co.
* Link-Belt Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
* Woods Sons Co., T. B.

Sheet Mill Machinery
Mesta Machine Co.

Shelving, Metal
Manufacturing Equipment & Engrg. Co.

Shipbuilding Machinery
Morgan Engineering Co.

Shredders
Jeffrey Mfg. Co.
* Williams Patent Crusher & Pulverizer Co.

Siphons (Steam-Jet)
Schutte & Koerting Co.

Sirens
(See Whistles, Steam)

Slitting Machines
* Bilton Machine Tool Co.

Sluice Gates
(See Gates, Sluice)

Smoke Recorders
Sarco Co.

Smoke Stacks and Flues
(See Stacks, Steel)

Sockets, Wire Rope
(See Wire Rope Fastenings)

Soot Blowing Systems
Diamond Power Specialty Co.

Special Machinery
* Brown Co., A. & F.
Builders Iron Foundry
Cowdrey Machine Works, C. H.
* Harris-Corliss Engine & Machine Co.
Holyoke Machine Co.
* Lammert & Mann
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
* Morris Co., I. P.
* Vilter Mfg. Co.
* Wood & Co., R. D.

Speed Transmissions, Variable
Moore & White Co.

Speed Reducing Transmissions
James Mfg. Co., D. O.

Spouts, Grain
* Caldwell & Son Co., H. W.

Spray Cooling Ponds, Nozzles, etc.
(See Cooling Ponds, Nozzles, etc., Spray)

Sprays, Water
* Spray Engineering Co.

Sprinklers, Spray
* Spray Engineering Co.

Sprockets
* Baldwin Chain & Mfg. Co.
* Caldwell & Son Co., H. W.
* Chain Belt Co.
Gifford-Wood Co.
* Hill Clutch Co.
* Lehigh Car, Wheel & Axle Works
* Link-Belt Co.

Square Hole Drills
(See Drills, Square Hole)

Stacks, Steel
* Bigelow Co.
* Casey-Hedges Co.
Connelly Boiler Co., D.
Graver Tank Works, Wm.
* Heine Safety Boiler Co.

Standpipes
Graver Tank Works, Wm.

Steam Engines, Separators, Shovels, Superheaters, Traps, Turbines, etc.
(See Engines, Separators, Shovels, Superheaters, Traps, Turbines, etc., Steam)

Steam Specialties
* Crane Co.
Davis Regulator Co., G. M.
Golden-Anderson Valve Specialty Co.
Lunkenheimer Co.
Morehead Mfg. Co.
* Pittsburgh Valve Fdry. & Const. Co.
Sarco Co., Inc.

Steel, Alloy
* Union Drawn Steel Co.

Steel, Bright Finished
* Union Drawn Steel Co.

Steel, Cold Drawn
* Union Drawn Steel Co.

Steel, Cold Rolled
Cumberland Steel Co.
* Union Drawn Steel Co.

Steel, Nickel
* Union Drawn Steel Co.

Steel, Open Hearth
* Union Drawn Steel Co.

Steel, Vanadium
* Union Drawn Steel Co.

Steering Engines
(See Engines, Steering)

Steel Plate Construction
* Bigelow Co.
* Casey-Hedges Co.
Connelly Boiler Co., D.
Graver Tank Works, Wm.
* Heine Safety Boiler Co.
* Hunt Machine Co., Rodney
* Wood & Co., R. D.

Stills
Connelly Boiler Co., D.
Graver Tank Works, Wm.

Stocks and Dies
* Greenfield Tap & Die Corpn.

Stokers, Chain Grate
* Babcock & Wilcox Co.
Combustion Engineering Corp.
* Green Engineering Co.
* Westinghouse Elec. & Mfg. Co.

Stokers, Overfeed
* Murphy Iron Works
* Westinghouse Elec. & Mfg. Co.

Stokers, Underfeed
American Engineering Co.
Combustion Engineering Corp.
* Riley Stoker Co., Ltd., Sanford.
* Westinghouse Elec. & Mfg. Co.

Stools and Chairs, Metal
Manufacturing Equipment & Engrg. Co.

Strainers, Water
Golden-Anderson Valve Specialty Co.
* Pittsburgh Valve Fdry. & Const. Co.
Schutte & Koerting Co.

Strainers, Water, Traveling
* Chain Belt Co.
* Link-Belt Co.

Structural Steel Work
Hendrick Mfg. Co.
Toledo Bridge & Crane Co.

Sugar Machinery
Hooven, Owens, Rentschler Co.
* Wood & Co., R. D.

Superheaters, Air
Power Specialty Co.

Superheaters, Steam
* Babcock & Wilcox Co.
* Heine Safety Boiler Co.
Power Specialty Co.
Superno Co., Inc.

Switchboards
* General Electric Co.
Sprague Electric Works
* Westinghouse Elec. & Mfg. Co.

Switches, Electric
* General Electric Co.
* Westinghouse Elec. & Mfg. Co.

Synchronous Converters
(See Converters, Synchronous)

Tachometers
Foxboro Co.
* Schaeffer & Budenberg Mfg. Co.
* Veeder Mfg. Co.
* Weston Electrical Instrument Co.

Tackle Blocks
(See Blocks, Tackle)

Tank Work (Air, Gas, Oil and Water)
* Bigelow Co.
* Casey-Hedges Co.
Connelly Boiler Co., D.
Graver Tank Works, Wm.
* Heine Safety Boiler Co.
* Scaife & Sons Co., Wm. B.
* Wood & Co., R. D.

Tanks, Car
Connelly Boiler Co., D.
Graver Tank Works, Wm.

Tanks, Storage
Connelly Boiler Co., D.
Graver Tank Works, Wm.
* Scaife & Sons Co., Wm. B.

Tanks, Welded
Graver Tank Works, Wm.
* Scaife & Sons Co., Wm. B.

Taps and Dies
* Greenfield Tap & Die Corpn.

Telescopic Oilers
(See Oilers, Telescopic)

Temperature Regulators
(See Regulators, Temperature)

Testing Laboratories, Electrical
Electrical Testing Laboratories

Textile Wet Finishing Machinery
* Hunt Machine Co., Rodney

Thermometers
* Ashton Valve Co.
Foxboro Co.
* Schaeffer & Budenberg Mfg. Co.
* Taylor Instrument Cos.

Thermometers, Distance
Foxboro Co.
* Taylor Instrument Cos.

Thread Cutting Tools
* Crane Co.
* Jones & Lamson Machine Co.
* Greenfield Tap & Die Corpn.

Time Controllers
(See Regulators, Time)

Time Recorders
Foxboro Co.

Tipples, Steel
Jeffrey Mfg. Co.
* Link-Belt Co.

Tools, Boring, Adjustable
Kelly Reamer Co.

Tools, Brass-Working Machine
* Warner & Swasey Co.

Tools, Machinists Small
* Atlas Ball Co.

Tools, Pipe Fitters
Walworth Mfg. Co.

Tools, Special
Cowdrey Machine Works, C. H.

Torches, Hand
* Best, W. N.

Track, Industrial
* Hunt Co., Inc., C. W.
Northern Engineering Works

Tramrail Systems, Overhead
Box & Co., Alfred
* Brown Hoisting Machinery Co.
* Ford Chain Block & Mfg. Co.
* Link-Belt Co.
Northern Engineering Works
* Shepard Electric Crane & Hoist Co.
Sprague Electric Works

Tramways, Bridge
* Brown Hoisting Machinery Co.
* Hunt Co., Inc., C. W.
* Link-Belt Co.
Toledo Bridge & Crane Co.

Tramways, Wire Rope
* Clyde Iron Works
* Roebling's Sons Co., John A.
* Lidgerwood Mfg. Co.

Transformers, Electric
* General Electric Co.
* Westinghouse Elec. & Mfg. Co.

Transmission Machinery
(See Power Transmission Machinery)

Traps, Condenser
Morehead Mfg. Co.

Traps, Return
* Crane Co.
Morehead Mfg. Co.

Traps, Steam
* Crane Co.
Davis Regulator Co., G. M.
Golden-Anderson Valve Specialty Co.
* Jenkins Bros.
* Johns-Manville Co., H. W.
Morehead Mfg. Co.
* Pittsburgh Valve Fdry. & Const. Co.
Sarco Co., Inc.
Schutte & Koerting Co.

Traps, Vacuum
* Crane Co.
Morehead Mfg. Co.
Sarco Co., Inc.

Trolleys, Mono-Rail
(See Tramrail Systems, Overhead)

Trucks, Electric
* Hunt Co., Inc., C. W.

Trucks, Mill
*American Vulcanized Fibre Co.

Tube Cleaners, Boiler
* Johns-Manville Co., H. W.

*Catalogue data of firms marked * appear in the A. S. M. E. Condensed Catalogues of Mechanical Equipment, 1917 Volume*

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I have no system to sell, but use modern business and factory methods after careful analysis of actual conditions.

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*American Vulcanized Fibre Co.

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* Goodrich Co., B. F.
Quaker City Rubber Co.

Tumbling Barrels
Northern Engineering Works
* Royersford Fdry. & Mch. Co.

Turbines, Hydraulic
Holyoke Machine Co.
* Morris Co., I. P.

Turbines, Steam
* General Electric Co.
* Westinghouse Elec. & Mfg. Co.

Turbo-Generators
* General Electric Co.
* Westinghouse Elec. & Mfg. Co.

Turntables
* Hunt Co., Inc., C. W.
* Link-Belt Co.
Northern Engineering Works

Turret Machines
* Jones & Lamson Machine Co.
Le Blond Machine Tool Co.
* Warner & Swasey Co.

Unions
* Crane Co.
Lunkenheimer Co.
* Pittsburgh Valve Fdry. & Const. Co.
Walworth Mfg. Co.

Uniflow Engines
(See Engines, Steam, Uniflow)

Underfeed Stokers
(See Stokers, Underfeed)

Unloaders, Air Compressor
Yarnall-Waring Co.

Unloaders, Ballast
* Lidgerwood Mfg. Co.

Unloaders, Car
*Link-Belt Co.

Vacuum Dryers, Pans, Pumps, Traps, etc.
(See Pans, Pumps, Traps, etc., Vacuum)

Vacuum Drying Apparatus
Buffalo Fdry. & Mch. Co.

Valve Balls
* Goodrich Co., B. F.

Valve Boxes
Ludlow Valve Mfg. Co.
* Wood & Co., R. D.

Valve Discs
* American Vulcanized Fibre Co.
* Goodrich Co., B. F.
* Jenkins Bros.
Quaker City Rubber Co.

Valves, Air, Automatic
Davis Regulator Co., G. M.
* Jenkins Bros.
* Smith Co., H. B.

Valves, Air Relief
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
Schutte & Koerting Co.

Valves, Altitude
Golden-Anderson Valve Specialty Co.

Valves, Ammonia
* Crane Co.
* De La Vergne Machine Co.
* Homestead Valve Mfg. Co.
* Jenkins Bros.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
* Vilter Mfg. Co.
Walworth Mfg. Co.

Valves, Back Pressure
* Crane Co.
Davis Regulator Co., G. M.
* Foster Engineering Co.
* Jenkins Bros.
Nelson Valve Co.
* Pittsburgh Valve Fdry & Const. Co.
Schutte & Koerting Co.
Walworth Mfg. Co.

Valves, Balanced
* Crane Co.
Davis Regulator Co., G. M.
* Foster Engineering Co.
Golden Anderson Valve Specialty Co.
* Homestead Valve Mfg. Co.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
Schutte & Koerting Co.
Walworth Mfg. Co.

Valves, Blowoff
Ashton Valve Co.
* Crane Co.
Golden-Anderson Valve Specialty Co.
* Homestead Valve Mfg. Co.
cialty Co.
* Jenkins Bros.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
* Pittsburgh Valve Fdry & Const. Co.
* Richardson-Phenix Co.
Walworth Mfg. Co.
Yarnall-Waring Co.

Valves, Butterfly
* Crane Co.
Lunkenheimer Co.
* Pittsburgh Valve Fdry & Const. Co.
Schutte & Koerting Co.

Valves, Check
* Crane Co.
Golden-Anderson Valve Specialty Co.
* Jenkins Bros.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
Nelson Valve Co.
* Pittsburgh Valve Fdry & Const. Co.
* Richardson-Phenix Co.
Schutte & Koerting Co.
Walworth Mfg. Co.
* Wood & Co. R. D.

Valves, Exhaust Relief
* Crane Co.
Davis Regulator Co., G. M.
* Jenkins Bros.
* Pittsburgh Valve Fdry & Const. Co.
Schutte & Koerting Co.
Walworth Mfg. Co.

Valves, Float
* Crane Co.
Davis Regulator Co., G. M.
Golden-Anderson Valve Specialty Co.
* Homestead Valve Mfg. Co.
Ludlow Valve Mfg. Co.
* Pittsburgh Valve Fdry & Const. Co.
Schutte & Koerting Co.

Valves, Foot
* Crane Co.
Ludlow Valve Mfg. Co.
* Pittsburgh Valve Fdry & Const. Co.
Walworth Mfg. Co.
* Wood & Co., R. D.

Valves, Gate
* Crane Co.
* Hunt Machine Co., Rodney
* Jenkins Bros.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
Nelson Valve Co.
* Pittsburgh Valve Fdry. & Const. Co.
Schutte & Koerting Co.
Walworth Mfg. Co.
* Wood & Co., R. D.

Valves, Globe, Angle and Cross
* Crane Co.
Golden-Anderson Valve Specialty Co.
* Jenkins Bros.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
Nelson Valve Co.
* Pittsburgh Valve Fdry. & Const. Co.
* Richardson-Phenix Co.
Walworth Mfg. Co.

Valves, Hose
* Crane Co.
* Jenkins Bros.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
Nelson Valve Co.
Walworth Mfg. Co.

Valves, Hydraulic
* Crane Co.
* Homestead Valve Mfg. Co.
Lunkenheimer Co.
Morgan Engineering Co.
Nelson Valve Co.
* Pittsburgh Valve Fdry. & Const. Co.
Schutte & Koerting Co.
Walworth Mfg. Co.
* Wood & Co., R. D.
Yarnall-Waring Co.

Valves, Hydraulic Operating
Lunkenheimer Co.
* Pittsburgh Valve Fdry. & Const. Co.
Schutte & Koerting Co.
* Wood & Co., R. D.

Valves, Non-Return
* Crane Co.
Davis Regulator Co., G. M.
Golden-Anderson Valve Specialty Co.
* Jenkins Bros.
Lunkenheimer Co.
Nelson Valve Co.
* Pittsburgh Valve Fdry. & Const. Co.
Schutte & Koerting Co.
Walworth Mfg. Co.

Valves, Plate, for Blowing Engines
Mesta Machine Co.

Valves, Plug
Golden-Anderson Valve Specialty Co.
* Homestead Valve Mfg. Co.

Valves, Pop Safety
* Ashton Valve Co.
* Crane Co.
Lunkenheimer Co.

Valves, Pump
* American Vulcanized Fibre Co.
* Goodrich Co., B. F.
Goulds Mfg. Co.
* Jenkins Bros.
* Johns-Manville Co., H. W.
Quaker City Rubber Co.

Valves, Radiator
* Crane Co.
* Jenkins Bros.
Lunkenheimer Co.
Walworth Mfg. Co.

Valves, Reducing
Davis Regulator Co., G. M.
Golden-Anderson Valve Specialty Co.

Valves, Regulating
* Crane Co.
Davis Regulator Co., G. M.
Golden-Anderson Valve Specialty Co.
Lunkenheimer Co.

Valves, Relief (Water)
* Ashton Valve Co.
* Crane Co.
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
* Wood & Co., R. D.

Valves, Safety
* Crane Co.
* Jenkins Bros.
Lunkenheimer Co.

Valves, Superheated Steam (Steel)
* Crane Co.
Golden-Anderson Valve Specialty Co.
* Jenkins Bros.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
Nelson Valve Co.
* Pittsburgh Valve Fdry. & Const. Co.
* Richardson-Phenix Co.
Schutte & Koerting Co.
Walworth Mfg. Co.

Valves, Stop and Check
(See Valve, Non-Return)

Valves, Throttle
* Crane Co.
Golden-Anderson Valve Specialty Co.
* Jenkins Bros.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
Nelson Valve Co.
* Pittsburgh Valve Fdry. & Const. Co.
* Richardson-Phenix Co.
Schutte & Koerting Co.

Ventilators
Nightingale & Childs Co.

Voltmeters
* General Electric Co.
* Westinghouse Elec. & Mfg. Co.
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Vulcanizers
* Bigelow Co.

Wash Bowls
Manufacturing Equipment & Engrg. Co.

Washers, Rubber
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Washers, Leather
* Schieren Co., Chas. A.

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(See Mills, Cinder, Water)

Water Circulators, Filters, Gages, Heaters, Meters, Strainers, etc.
(See Circulators, Filters, Gages, Heaters, Meters, Strainers, etc., Water)

Water Columns
* Ashton Valve Co.
Lunkenheimer Co.
Walworth Mfg. Co.

Water Columns, Railway
Golden-Anderson Valve Specialty Co.

Water Controlling Apparatus
* Hunt Machine Co., Rodney

Water Purifying Plants
* Scaife & Sons Co., Wm. B.

Water Softeners
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* Scaife & Sons Co., Wm. B.

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* Morris Co., I. P.

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* Texas Co.

Wattmeters
* General Electric Co.
* Westinghouse Elec. & Mfg. Co.
* Weston Electrical Instrument Co.

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* Pittsburgh Valve Fdry. & Const. Co.

Welding Equipment, Electric
* Quasi-Arc Weldrobe Co., Inc.

Wheels, Car
* Lehigh Car, Wheel & Axle Works

Wheels, Polishing, Paper
Rockwood Mfg. Co.

Whistles, Steam
* Ashton Valve Co.
* Brown Co., A. & F.
* Crane Co.
Lunkenheimer Co.
Walworth Mfg. Co.

Winches
* Brown Hoisting Machinery Co.
* Lidgerwood Mfg. Co.

Wire, Brass and Copper
* Roebling's Sons Co., John A.

Wire, Flat
* Roebling's Sons Co., John A.

Wire, Iron and Steel
* Roebling's Sons Co., John A.

Wire and Cables, Electrical
* General Electric Co.
* Roebling's Sons Co., John A.

Wire Cloth
* Caldwell & Son Co., H. W.

Wire Rope
(See Rope, Wire)

Wire Rope Fastenings
* Lidgerwood Mfg. Co.
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Wire Rope Slings
* Roebling's Sons Co., John A.

Wiring Devices
* General Electric Co.

Wrenches
* Greene, Tweed & Co.
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Wrenches, Tap
* Greenfield Tap & Die Corpn.

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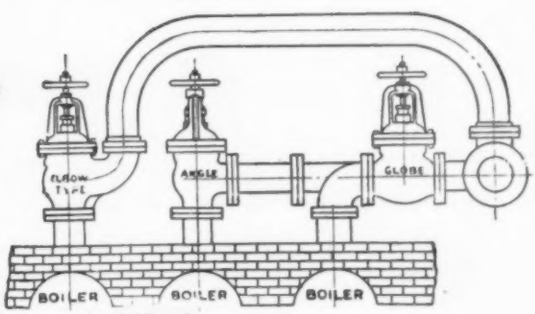
"I Never Worry"

"That's My Plan"



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Automatic Double Cushioned Triple Acting and Non-Return Valves

They work both ways protecting power-plant—the boilers and steam lines. "Life and property insurance valves."

1st. Prevent expensive shutdowns.
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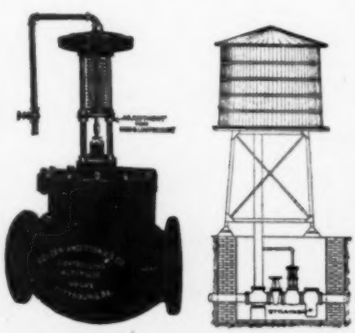

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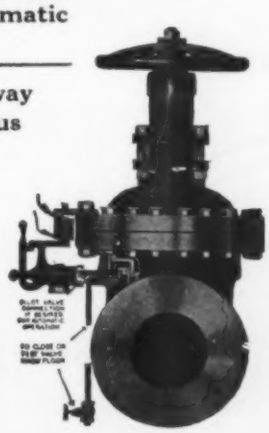

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1228 FULTON BUILDING, PITTSBURGH, PA.

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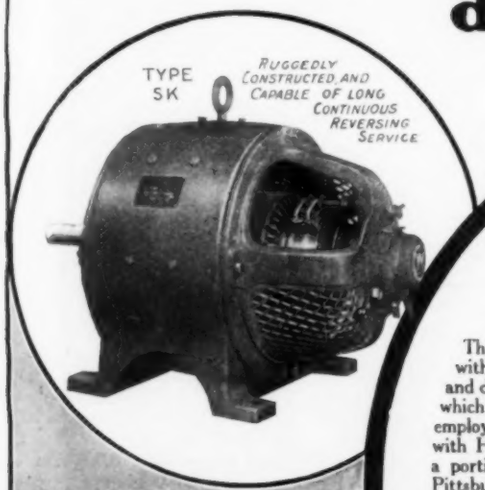
Westinghouse

Reversing Planer Motors and Control



The Right Motor At The Right Time

The right motor is the one that will give you the most intense production, combined with high efficiency and utmost reliablity. The right time for such a motor is NOW, and during the COMING days of increasing demand upon us. The car shop, upon which our government must depend primarily for means of transportation, is obliged to employ those methods which insure MAXIMUM OUTPUT in MINIMUM TIME with HIGHEST EFFICIENCY. The accompanying views show a portion of the machine shops of the Pressed Steel Car Co. of Pittsburgh and the Westinghouse Reversing Planer Motors employed on these planers. Westinghouse Automatic Control, also installed, so simplifies the work of the operator that there is no loss of time.

It has taken a great deal of study of machine tool practice to bring our Motors and Control Equipment up to their present acknowledged high standard. Let us help you put your plant on the most efficient basis NOW. It's the right time.

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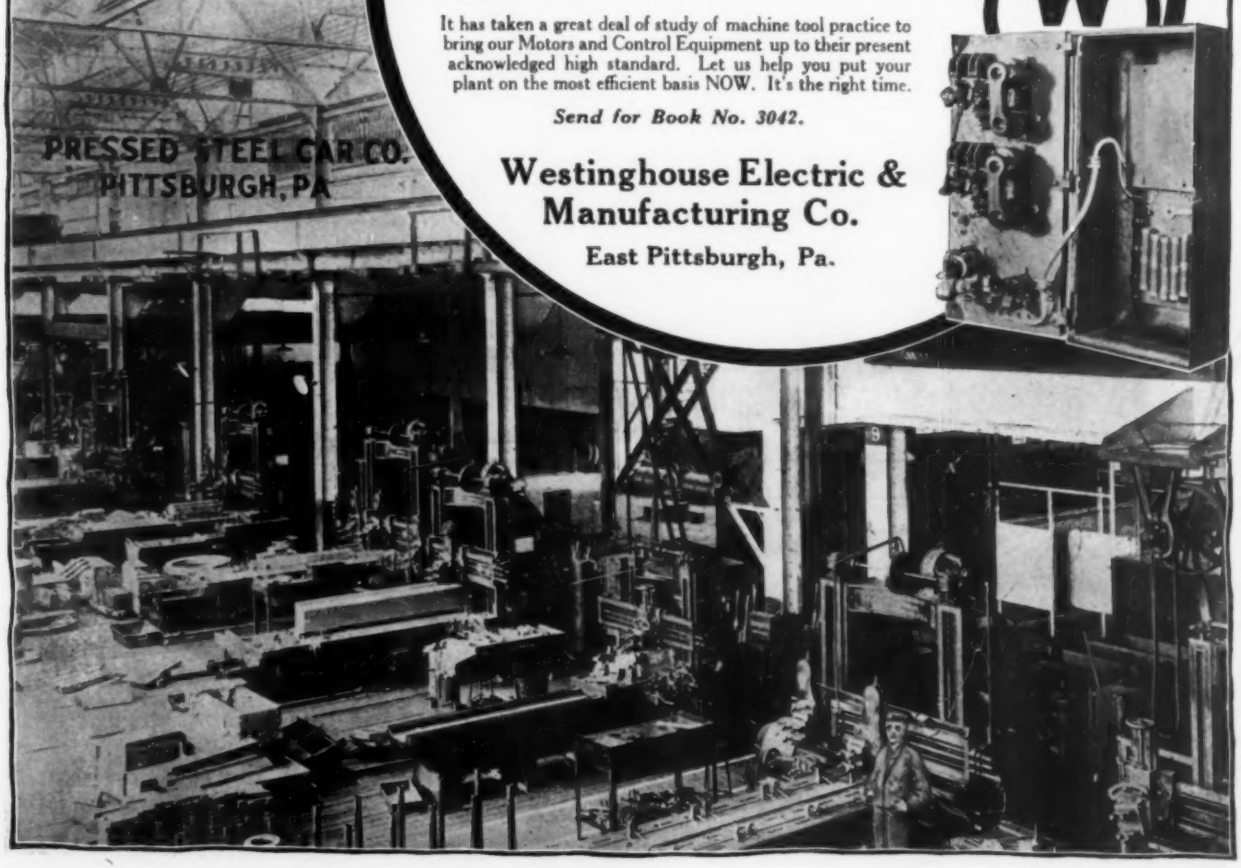
East Pittsburgh, Pa.



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HAVE NO EFFECT ON
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For more than 2 weeks this 7" DUXBAK Belt ran 21 hours out of every 24, under a constant shower of hot water and live steam under a temperature varying from 60 to 100 degrees Fahrenheit, and today it is as perfect as when installed.

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Denver . . 1752 Arapahoe St.	Salt Lake City, 115 W. 2nd So. St.
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Oak Leather Tanneries, Bristol, Tenn.

P-11

THE ANNUAL MEETING

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West Thirty-ninth Street, New York

THE Thirty-Eighth Annual Meeting of The American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York, beginning on Tuesday, December 4, and ending on Friday, December 7, 1917. The dominant theme of the meeting will be *The Engineers' Part in the War* and the call is issued to every member to attend. Come to this meeting, confer with your fellow members and return with strength renewed to shoulder the enormous tasks which the engineer must bear in this engineering war!

The last convention, which occurred at Cincinnati just after the entrance of our country into the war, was by far the largest Spring Meeting ever held by the Society; and it is expected that the same impelling force—the opportunity for conference in the present crisis, and for coördination and unification of effort—will make the coming Annual Meeting the greatest convention in the history of the Society.

CALVIN W. RICE, *Secretary*

LIST OF EVENTS

Tuesday, December 4

Headquarters open for registration at 12:00 m.

Public Meeting of the Gage Committee at 2:00 p.m.

Interest will center in the opening session on Tuesday evening, the occasion being the conferring of Honorary Membership upon Maj.-Gen. George W. Goethals, with an address by Hon. William H. Taft, ex-President of the United States. The introduction of the President-elect and the President's reception will come on this evening.

Tickets for the President's Reception may be obtained at the cashier's desk at the time of registration, but owing to the limited capacity of the reception room and the large attendance expected they can be issued only to members and their immediate friends.

Wednesday, December 5

An all-day session on the general theme of the Service of the Engineer to the Public in Times of Crises will be held on Wednesday. This will be the keynote session of the meeting, with the following program:

UNIVERSAL PUBLIC SERVICE IN PEACE AND WAR, Dr. Ira N. Hollis, President, The American Society of Mechanical Engineers

THE ENGINEERING SOCIETIES IN THE NATIONAL DEFENSE, Gano Dunn, President, J. G. White Engineering Corporation, New York

SPECIAL EDUCATION IN TIME OF WAR, Dr. Charles S. Howe, President, Case School of Applied Science, Cleveland, Ohio

Wednesday, Continued

THE AGRICULTURAL PROBLEM, Dr. W. H. Jordan, Director, New York Agricultural Experiment Station, Geneva, N. Y.

THE FUEL PROBLEM, Prof. L. P. Breckenridge, Sheffield Scientific School, Yale University, New Haven, Conn.

ENGINEERING RESEARCH, Mr. C. E. Skinner, Engineer Research Division, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

MOTOR TRANSPORTATION, Mr. William P. Kennedy, Consulting Engineer, New York

ARMY TRANSPORTATION, Major L. B. Moody, Carriage Division of the Ordnance Department, Washington, D. C.

THE AIRCRAFT PROBLEM, Prof. W. F. Durand, Chairman National Advisory Committee on Aeronautics, Washington, D. C.

THE SOLUTION OF THE CANTONMENT CONSTRUCTION PROBLEM, Mr. Leonard Metcalf, Consulting Engineer, Boston, Mass.

Other speakers to be announced later.

Before beginning the keynote session the usual Wednesday morning business meeting will be called, which, however, it is expected, will be adjourned to Thursday morning to allow time for events which are to follow. The membership is to be honored by the presentation to the Society of a bust of Rear-Admiral Benjamin F. Isherwood.

Simultaneous with the continuation of the keynote session in the afternoon will be three sessions devoted respectively to power-plant subjects; to general papers technical in character; and to codes prepared by the Sub-Committee on Protection of Industrial Workers, on Safety Standards for Elevators and Woodworking Machinery.

The day will conclude with a Smoker—a get-together meeting for members, with an interesting talk illustrated by stereopticon by Mr. John R. Freeman, Past-President Am.Soc.M.E., on his trip to the Orient taken last winter with Dr. John A. Brashear and Mr. Ambrose Swasey, Past-Presidents Am.Soc.M.E. Music and other entertainment will be provided and there will be a general good time.

Thursday, December 6

In the morning, continuation of Business Meeting, followed by a session under the auspices of the Sections Committee for a discussion by delegates from the Sections throughout the country. This will give an opportunity for a comparison of methods which have proved most successful, both in relation to the Sections themselves and to the Society at large. There will also be a general session.

At 12:30 p.m., luncheon, with an address by Prof. Dexter S. Kimball, of Cornell University, on the Relation of Industrial Management to Engineering. The event is significant in that it recognizes modern tendencies relating to industrial life and the management of industry. Professor Kimball will discuss industrial management broadly, touching upon the social aspects of the problem, Americanization, etc.

As a result of the interest displayed at the last Spring Meeting in the long discussion which then took place on the manufacture of munitions, a session will be devoted to the related subject of Inspection in Munitions Manufacture. This will be under the

auspices of the Sub-Committee on Machine-Shop Practice and will occur on Thursday afternoon.

Another strong session on this afternoon will be under the auspices of the Sub-Committee on Textiles, with papers on the labor problem in the textile industries and on accident prevention, as well as on more technical subjects.

In the evening Dr. John A. Brashear, Past-President Am.Soc.M.E., will give his famous lecture on The Science of the Beautiful in Commonplace Things, illustrated by many interesting demonstrations and strikingly beautiful pictures. This will be one of the most delightful occasions that it has been the privilege of the members of the Society to attend.

Friday, December 7

Two events of great importance have been reserved for Friday morning, which is the closing period of the meeting. One of these will be a session devoted to two current problems which wartime conditions have developed; namely, the increasing employment of women in such industrial plants as machine shops and munition works; and the preparatory work now being undertaken for training the large numbers of crippled men who may be expected to return from the war and who will need to become efficient and self-supporting.

The second event is a public hearing by the Power Test Committee, which two years ago issued an elaborate code giving directions for testing prime movers of various types and auxiliary apparatus. This hearing is preliminary to a proposed revision of the code. Various societies and other organizations interested, railroads, firms and colleges, have been asked to send representatives, so that all views may be presented and the code eventually become a standard of tests throughout the country.

COMMITTEE REPORTS AND COMMITTEE MEETINGS

Besides the Industrial Safety Codes to be discussed, as listed above, other reports are expected which represent long and untiring service on the part of committee members. It is hoped that these may include the report of the Committee on Screw-Thread Tolerances which has been in preparation for the past three years, and reports by sub-committees of the Research Committee on flow meters and lubrication. These will probably be assigned to the business meeting on Wednesday or Thursday morning.

The activities of the Society's committees, especially on war problems, is further evidenced by various committee meetings called for the week of the convention, including the meeting of the Gage Committee appointed to assist the Government in securing standard gages in munitions work, and a joint meeting of the A.S.M.E. and S.A.E. committees on Steel Roller Chains.

SECTIONS' AND STUDENTS' CONFERENCES

During the meeting there are to be several conferences of the delegates from the 22 Local Sections. Representatives from Student Branches will also meet together and on Friday evening will be the annual college reunions.

ENTERTAINMENT

The New York Local Committee and the Ladies Committee are desirous of giving every attendant at the Annual Meeting a hearty welcome, and it is particularly urged that any who are not acquainted will speak to those wearing badges so that they may be made to feel that they are at home and one of the large family of the Society.

There will be a few excellent excursions and members of the New York Local Committee will hold themselves in readiness to conduct personally any members who wish to make special or individual trips.

COMING SECTION MEETINGS

Baltimore, December 19: The next meeting of the Section will be held at the Engineers' Club on this date at 8 p.m. and the two following papers will be presented: Micro-structure and Physical Properties of Metals, by Dr. D. F. McAdams, Jr., of the Engineering Experiment Station, U. S. Naval Academy, Annapolis, and Some Problems of the Fertilizer Industry, by Mr. Samuel P. Whiteside.

Philadelphia, November 27: The Section will give a dinner at the Engineers' Club on this date, after which the following interesting papers will be read: Manufacturing in Relation to Banking, Research and Management, by Prof. Walter Rautenstrauch, Mem.Am.Soc.M.E. After the paper the meeting will be given over to a discussion of Society affairs, with particular reference to the work of Local Sections. The Committee on Sections will be present.

Philadelphia, December 11: A joint meeting of the Philadelphia Section with The Franklin Institute will be held on December 11, at which Joseph A. Steinmetz, Mem. Am.Soc.M.E., will give a talk on Offensive Against the Submarine.

Philadelphia, January 22: Paper to be read on Our Navy and the War, by Prof. Wm. L. Cathcart, Mem.Am.Soc.M.E., U.S.N. (retired).

Providence, December 5: Structural Section. Paper to be read on Foundation Work in Providence.

Providence, December 10: Fire Insurance Section. Paper to be read on Manufacture and Storage of the Moving Picture Film from the Fire Insurance Standpoint, by F. J. Hoxie, Special Inspector for the Associate Manufacturers Mutual Fire Insurance Company.

Providence, December 11: Designers' and Draughtmen's Section. Paper to be read on Driving Chain, its Use and Limitations, by A. H. Morse, of the Morse Chain Company.

Providence, December 21: Chemical Section. Paper to be read on From the Coal Pile to the Lamp, by Jesse E. Gray, Chief Engineer of the Narragansett Electric Lighting Company.

ADVERTISING SECTION

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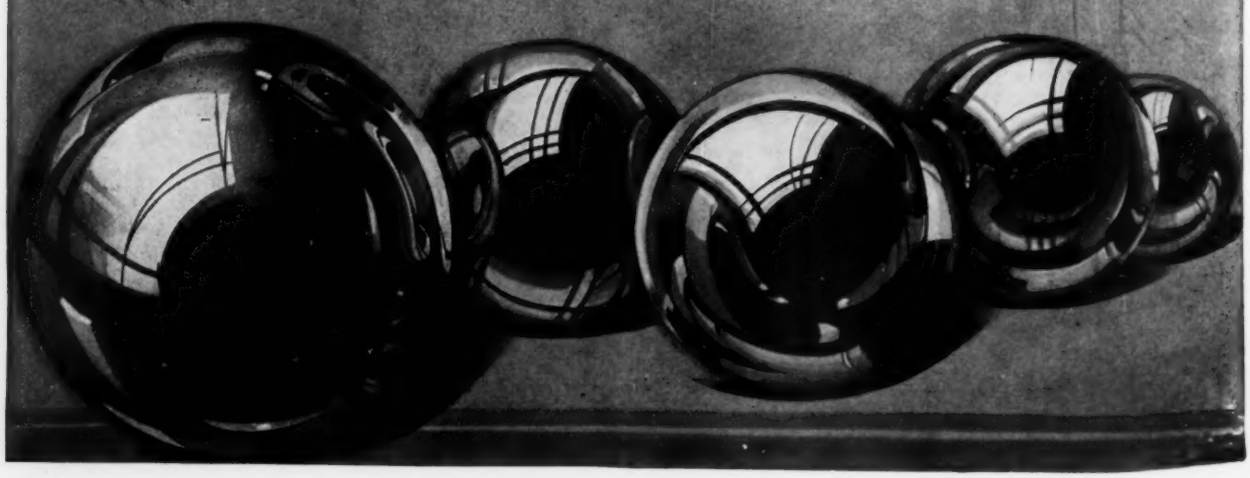

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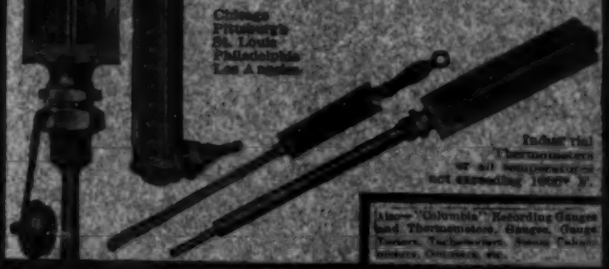

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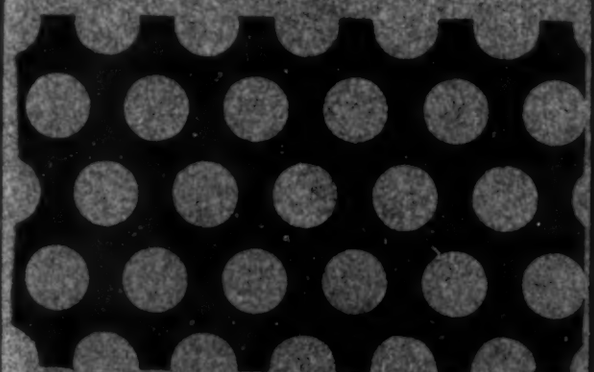

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